

(19) 日本国特許庁(JP)

(12) 公開特許公報(A)

(11) 特許出願公開番号

特開2004-63465

(P2004-63465A)

(43) 公開日 平成16年2月26日(2004.2.26)

(51) Int. Cl.⁷

H05B 33/14

C09K 11/06

F I

H05B 33/14

C09K 11/06

C09K 11/06

C09K 11/06

C09K 11/06

B

610

620

635

640

テーマコード(参考)

3K007

審査請求 未請求 請求項の数 6 O L (全 29 頁) 最終頁に続く

(21) 出願番号 特願2003-199678 (P2003-199678)
 (22) 出願日 平成15年7月22日(2003.7.22)
 (31) 優先権主張番号 10/207686
 (32) 優先日 平成14年7月26日(2002.7.26)
 (33) 優先権主張国 米国(US)
 (31) 優先権主張番号 10/372547
 (32) 優先日 平成15年2月24日(2003.2.24)
 (33) 優先権主張国 米国(US)

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(54) 【発明の名称】 アントラセン誘導体及びトリアジン誘導体を含むディスプレイ装置

(57) 【要約】

【課題】優れた性能、例えば、操作安定性及び色純度等を有する装置を提供することにある。

【解決手段】アノード、

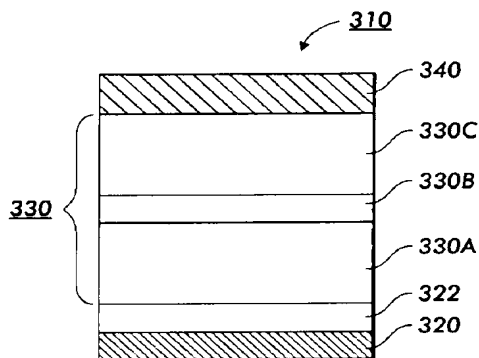
カソード、及び

カソードとアノードの間の発光領域

を含む装置であって、その発光領域がアントラセン誘導体化合物及びトリアジン誘導体化合物を含むことを特徴とする装置。

【選択図】

図3



【特許請求の範囲】

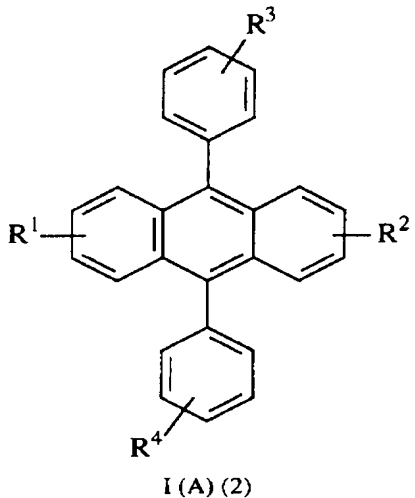
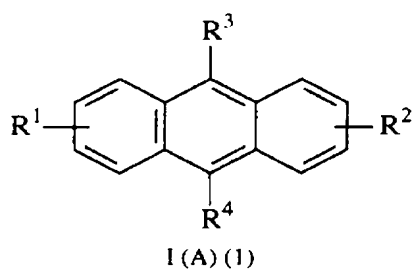
【請求項 1】

アノード、
 カソード、及び
 カソードとアノードの間の発光領域
 を含む装置であって、その発光領域がアントラセン誘導体化合物及びトリアジン誘導体化合物を含むことを特徴とする装置。

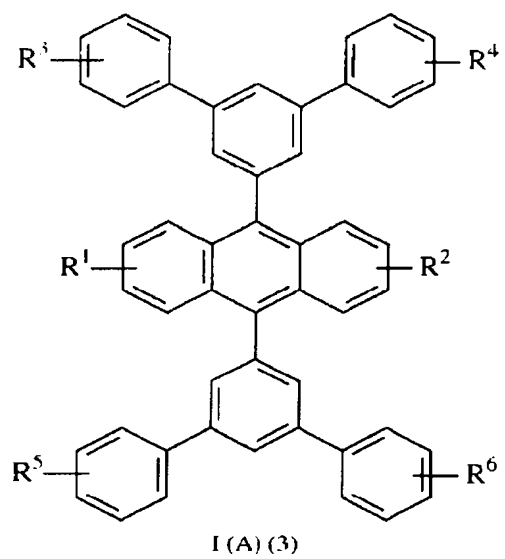
【請求項 2】

アノード、
 カソード、及び
 カソードとアノードの間の発光領域
 を含む装置であって、その発光領域がアントラセン誘導体化合物及びトリアジン誘導体化合物を含み、アントラセン誘導体化合物が式 I (A) (1) ～ I (A) (11)、式 I (B)、式 I (C)、及び式 I (D)：

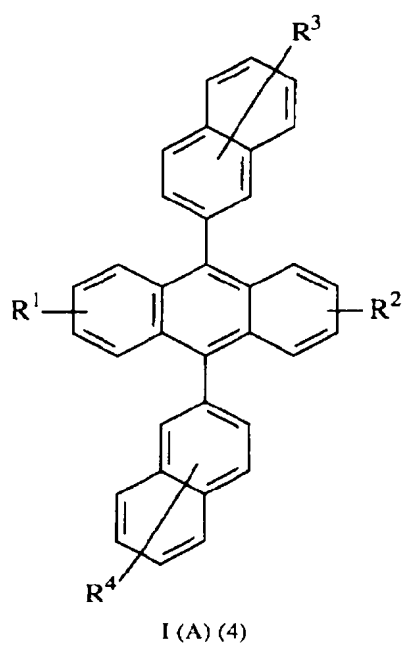
【化 1】



【化 2】



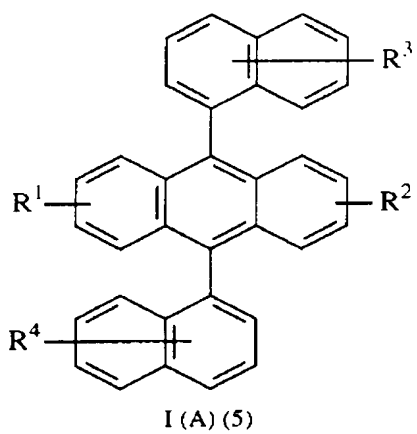
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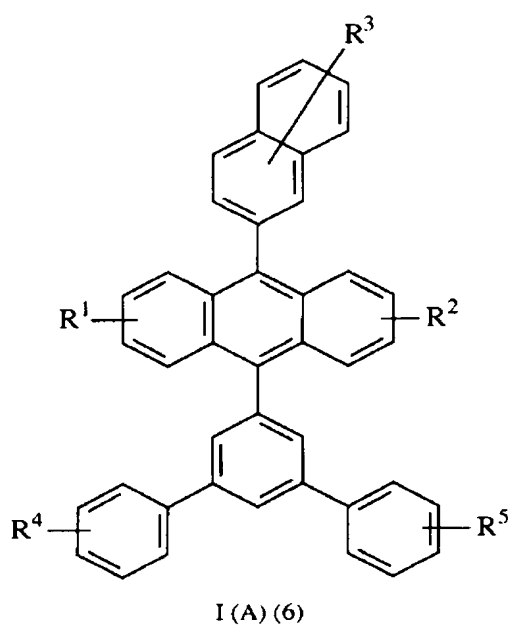
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【化 3】



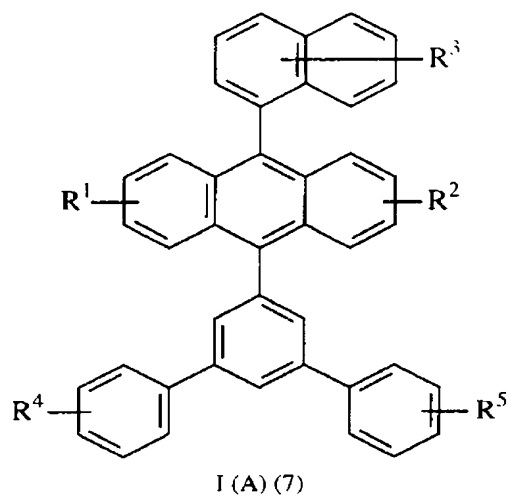
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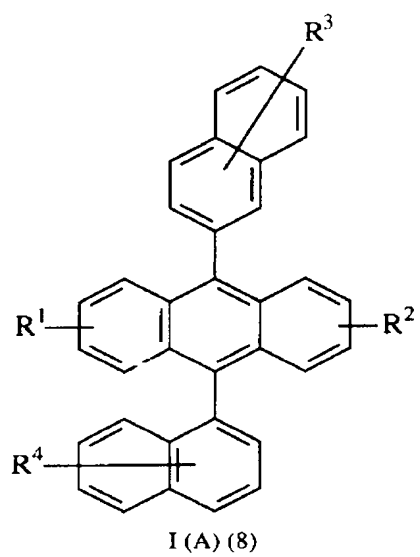
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【化 4】



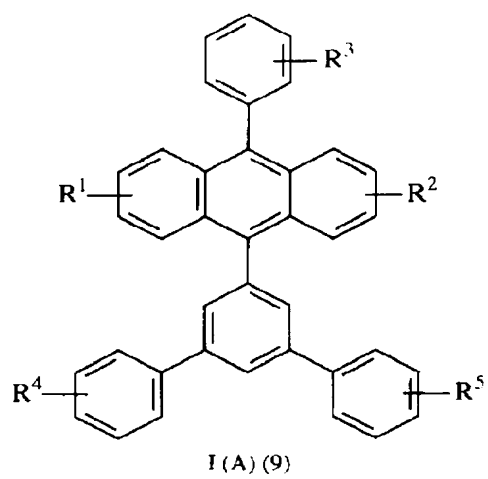
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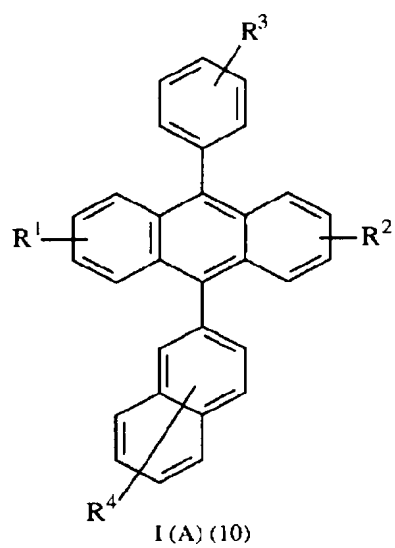
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【化 5】



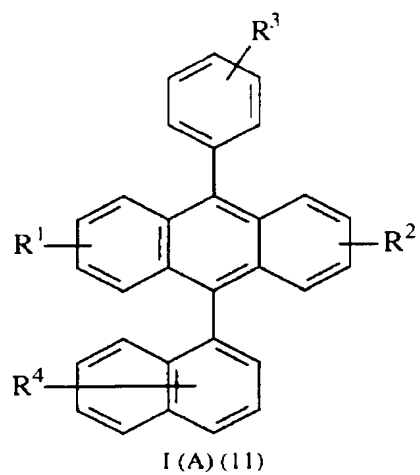
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【化 6】

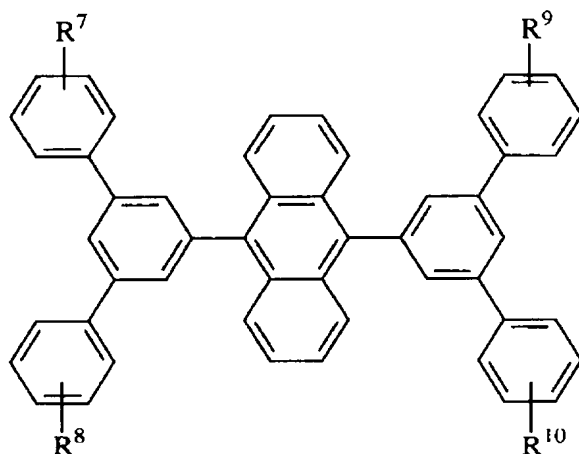


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(式中、置換基 R^1 、 R^2 、 R^3 、 R^4 、 R^5 及び R^6 は夫々独立に水素、1～24個の炭素原子のアルキル、1～9個の炭素原子のアルコキシ、トリフェニルシリル、6～20個の炭素原子のアリール（これは必要により置換されていてもよい）、5～24個の炭素原子のヘテロアリール（これは必要により置換されていてもよい）、ハロゲン、及びシアノ基からなる群から選ばれる）

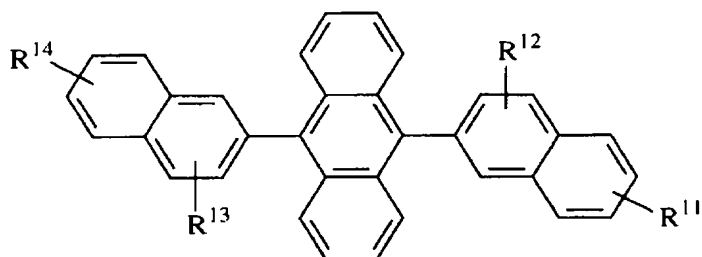
【化7】



I(B)

(式中、置換基 R^7 、 R^8 、 R^9 、及び R^{10} は夫々独立に
 群1：水素、又は1～24個の炭素原子のアルキル；
 群2：6～20個の炭素原子のアリール（これは必要により置換されていてもよい）；
 群3：ナフチル、アントラセニル、ビレニル、又はペリレニルの縮合芳香族環を完成するのに必要な炭素原子；
 群4：5～24個の炭素原子のヘテロアリール（これは必要により置換されていてもよい）；
 群5：フリル、チエニル、ピリジル、又はキノリニルの縮合ヘテロ芳香族環；
 群6：1～24個の炭素原子のアルコキシ基、アミノ基、アルキルアミノ基、又はアリールアミノ基；及び
 群7：フッ素、塩素、臭素又はシアノ
 からなる群から選ばれる）；

【化8】



I(C)

(式中、置換基 R^{11} 、 R^{12} 、 R^{13} 、及び R^{14} は夫々独立に
 群1：水素、又は1～24個の炭素原子のアルキル；
 群2：6～20個の炭素原子のアリール（これは必要により置換されていてもよい）；
 群3：ナフチル、アントラセニル、ビレニル、又はペリレニルの縮合芳香族環を完成するのに必要な炭素原子；
 群4：5～24個の炭素原子のヘテロアリール（これは必要により置換されていてもよい）

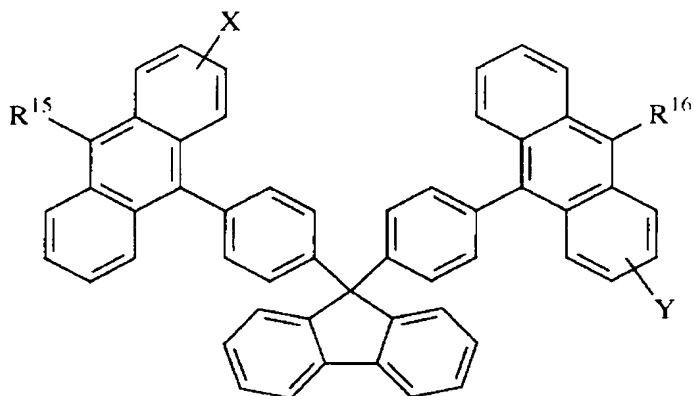
)、フリル、チエニル、ピリジル、キノリニルの縮合ヘテロ芳香族環を完成するのに必要な炭素原子；

群 5：1～24個の炭素原子のアルコキシ基、アミノ基、アルキルアミノ基、又はアリールアミノ基；及び

群 6：フッ素、塩素、臭素又はシアノ

からなる群から選ばれる)；

【化 9】



I (D)

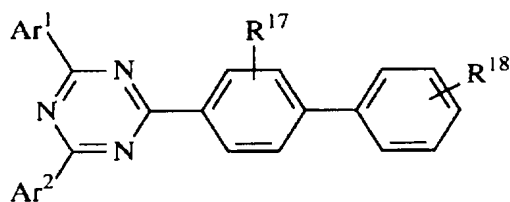
(式中、 R^{15} 及び R^{16} は独立に水素、1～約6個の炭素原子を有するアルキル基、約6～約30個の炭素原子を有するアリール基からなる群から選られ、

X 及び Y は独立に水素、1～約6個の炭素原子を有するアルキル基、約6個～約30個の炭素原子を有するアリール基、1～約6個の炭素原子を有するアルコキシ基、ハロゲン、シアノ基からなる群から選ばれる)

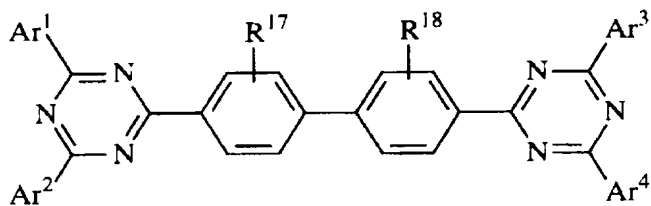
からなる群から選られ、かつ

トリアジン誘導体化合物が式 II (A)、II (B)、II (C)、及び II (D)：

【化 10】

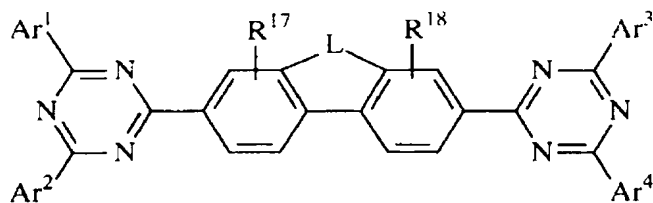


II (A)

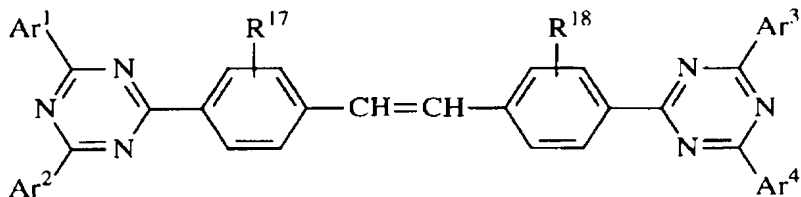


II (B)

【化 1 1】



II (C)



II (D)

(式中、 Ar^1 、 Ar^2 、 Ar^3 、及び Ar^4 は夫々独立に6～約20個の炭素原子のアリール（これは必要により置換されていてもよい）であり、 R^{17} ～ R^{18} は独立に水素、1～約6個の炭素原子を有する脂肪族基、1～約6個の炭素原子を有するアルコキシ基、ハロゲン、シアノ基からなる群から選ばれ、かつ L は $-C(R' R'')$ 、 $-CH=CH-$ 、 $-Si(R' R'')$ 、酸素原子、硫黄原子からなる群から選ばれた2価の基であり、 R' 及び R'' は夫々独立に水素原子、1～約10個の炭素原子を含むアルキル基、及び1～約10個の炭素原子を含むアルコシル基である）からなる群から選ばれることを特徴とする装置。

【請求項3】

アントラセン誘導体化合物が式I(A)(4)及び式I(D)からなる群から選ばれる請求項2記載の装置。

【請求項4】

トリアジン誘導体化合物が式I(B)から選ばれる請求項2記載の装置。

【請求項5】

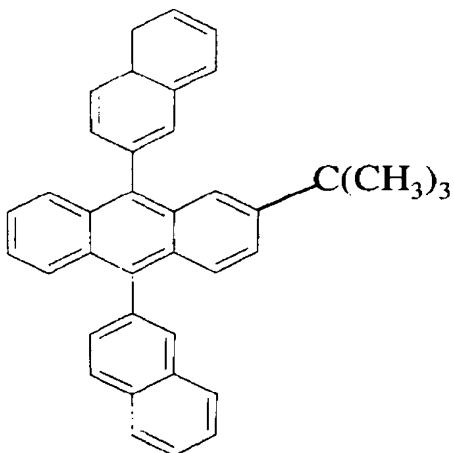
アントラセン誘導体化合物が

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【化 1 2】



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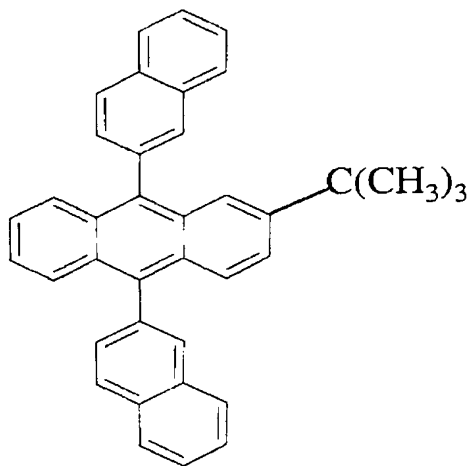
BH2.

である請求項 2 記載の装置。

【請求項 6】

アントラセン誘導体化合物が

【化 1 3】



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BH2.

である請求項 1 記載の装置。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】

本発明は親の米国特許出願第 10 / 207, 687 号 (2002 年 7 月 26 日に出願された) の一部継続出願であり、これから優先権が主張される。

【0002】

【発明が解決しようとする課題】

しかしながら、青色放出 OLED の性能を改良し、更に特別にはそれらの操作安定性を増大し、色純度を高めるようにとの要望があり、本発明はそれに取り組む。

【0003】

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【課題を解決するための手段】

本発明は実施態様において

アノード、

カソード、及び

カソードとアノードの間の発光領域を含む装置であって、その発光領域がアントラセン誘導体化合物及びトリアジン誘導体化合物を含む装置；そのアントラセン誘導体化合物が式 I (A) (1) ~ I (A) (11)、式 I (B)、式 I (C)、及び式 I (D) からなる群から選ばれ、かつトリアジン誘導体化合物が式 II (A)、II (B)、II (C)、及び II (D) (これらの式及び置換基は本明細書に説明される) からなる群から選ばれた装置を提供することにより達成される。

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【0004】

【発明の実施の形態】

(1) “層”という用語は一般に隣接層の組成物とは異なる組成物を有する単一被覆物を示す。

(2) “領域”という用語は単層、複数の層、例えば、2層、3層又はそれより多い層、及び／又は一つ以上の“ゾーン”を表す。

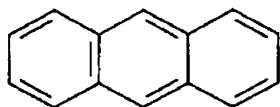
(3) 電荷輸送ゾーン（即ち、正孔輸送ゾーン及び電子輸送ゾーン）及び発光ゾーンに関して使用される“ゾーン”という用語は、単層、複数の層、層中の単一の機能性領域、又は層中の複数の機能性領域を表す。

(4) アントラセン誘導体化合物という用語は下記の構造式

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【0005】

【化14】



I

【0006】

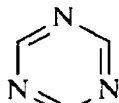
により表されるような三つの縮合ベンゼン環の同じ構造単位を全て含む関連する未置換化合物及び置換化合物のファミリーを表し、この場合、アントラセン誘導体化合物の例示の例が本明細書に示される。

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(5) トリアジン誘導体化合物という用語はベンゼンのCH原子のいずれか三つが連続様式又は非連続様式、例えば、1, 2, 3位、1, 2, 4位、1, 2, 5位、1, 2, 6位、又は1, 3, 5位で窒素原子により置換されている芳香族複素環の同じ構造単位を全て含む関連する未置換化合物及び置換化合物のファミリーを表す。窒素原子による置換は式

【0007】

【化15】



II

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【0008】

により表されるように、例えば、1, 3, 5位であってもよく、この場合、トリアジン誘導体化合物の例示の例が本明細書に示される。

(6) アントラセン誘導体化合物及び／又はトリアジン誘導体化合物を含む層が電極又はその他の非発光領域の機能上又は物理上の部分であると同等に見られる実施態様において、ここにおける便宜はアントラセン誘導体化合物及び／又はトリアジン誘導体化合物を含

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むこのような層が発光領域の一部と考えられることである。

(7) “非アントラセンかつ非トリアジン誘導体化合物”という用語はアントラセン誘導体化合物及びトリアジン誘導体化合物以外の化合物を表す。

本有機発光装置(“OLED”)は発光領域内に少なくとも一種のアントラセン誘導体化合物及び少なくとも一種のトリアジン誘導体化合物を含む。あらゆる好適な層順序及び層組成が本発明を達成するのに使用されてもよい。

第一の例示の実施態様が図1に示され、図中、OLED 110は示された順序で、アノード120、発光領域130、及びカソード140を含む。

第二の例示の実施態様が図2に示され、図中、OLED 210は示された順序で、第一電極220、発光ゾーン230B及び電荷輸送ゾーン230Aを含む発光領域230；並びに第二電極240を含む。第一電極はカソードであってもよく、一方、第二電極はアノードである。また、第一電極はアノードであってもよく、一方、第二電極はカソードである。第二電極がアノードである場合、電荷輸送ゾーンは正孔輸送ゾーンであってもよい。また、第二電極がカソードである場合、電荷輸送ゾーンは電子輸送ゾーンであってもよい。

【0009】

第三の例示の実施態様が図3に示され、図中、OLED 310は示された順序で、アノード320；任意の緩衝層322；正孔輸送ゾーン330A、発光ゾーン330B、及び電子輸送ゾーン330Cを含む発光領域330；並びにカソード340を含む。

便宜のために、支持体が図1-3に示されていない。しかしながら、支持体は示されたOLED中のあらゆる好適な場所に、例えば、両電極と接触して配置されてもよいことが理解される。

少なくとも一種のトリアジン誘導体化合物は一種、二種、三種又はそれより多い化合物として存在してもよい。二種以上のトリアジン誘導体化合物が存在する場合、それらは等しい比又は等しくない比の混合物であってもよく、又はトリアジン誘導体化合物は混合されない状態であってもよく、例えば、異なる層又は単層の異なる領域中に別々に配置されてもよい。実施態様において、少なくとも一種のトリアジン誘導体化合物は電子輸送物質と考えられてもよい。何とならば、電子の輸送がトリアジン誘導体化合物により正孔の輸送より大きいからである。実施態様において、幾つかのトリアジン誘導体化合物は、電子輸送体であることに加えて、また青色エミッター、即ち、正孔及び電子が化合して可視スペクトルの青色領域の光の放出をもたらし得る物質であってもよい。

【0010】

少なくとも一種のアントラセン誘導体化合物は一種、二種、三種又はそれより多い化合物として存在してもよい。二種以上のアントラセン誘導体化合物が存在する場合、それらは等しい比又は等しくない比の混合物であってもよく、又はアントラセン誘導体化合物は混合されない状態であってもよく、例えば、異なる層又は単層の異なる領域中に別々に配置されてもよい。少なくとも一種のアントラセン誘導体化合物は青色エミッター、即ち、正孔及び電子が化合して可視スペクトルの青色領域の光の放出をもたらし得る物質と考えられてもよい有機電気発光物質の型である。実施態様において、幾つかのアントラセン誘導体化合物はまた不十分、かなりの、良好な、又は優れたレベルで正孔、電子、又は正孔と電子の両方を輸送することができてもよい。実施態様において、アントラセン誘導体化合物は青色エミッター及び電荷伝導体の両方であってもよいので、この二重の性質はOLED中のアントラセン誘導体化合物の配置に或る程度の融通性を可能にする。

【0011】

少なくとも一種のアントラセン誘導体化合物及び少なくとも一種のトリアジン誘導体化合物は本OLED、例えば、下記の例示のOLED配置(二種以上のアントラセン誘導体化合物がOLED中に存在する場合、このようなアントラセン誘導体化合物は互いに同じであってもよく、また異なってもよく；また二種以上のトリアジン誘導体化合物がOLED中に存在する場合、このようなトリアジン誘導体化合物は互いに同じであってもよく、また異なってもよい)の層、二層又はそれより多い層、ゾーン、又は領域中に存在し

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てもよい。

(1) アノード／発光ゾーン（アントラセン誘導体化合物）／電子輸送ゾーン（トリアジン誘導体化合物）／カソード

(2) アノード／発光ゾーン（アントラセン誘導体化合物＋トリアジン誘導体化合物）／電子輸送ゾーン（非アントラセンかつ非トリアジン誘導体化合物）／カソード

(3) アノード／発光ゾーン（アントラセン誘導体化合物＋トリアジン誘導体化合物）／電子輸送ゾーン（トリアジン誘導体化合物）／カソード

(4) アノード／発光ゾーン（アントラセン誘導体化合物＋トリアジン誘導体化合物）／電子輸送ゾーン（アントラセン誘導体化合物＋トリアジン誘導体化合物）／カソード

(5) アノード／発光ゾーン（アントラセン誘導体化合物）／電子輸送ゾーン（アントラセン誘導体化合物＋トリアジン誘導体化合物）／カソード

【0012】

(6) アノード／発光ゾーン（アントラセン誘導体化合物）／電子輸送ゾーン（アントラセン誘導体化合物＋トリアジン誘導体化合物の第一層、及びトリアジン誘導体化合物の第二層）／カソード

(7) アノード／発光ゾーン（アントラセン誘導体化合物）／電子輸送ゾーン（アントラセン誘導体化合物＋トリアジン誘導体化合物の第一層、及び非アントラセンかつ非トリアジン誘導体化合物の第二層）／カソード

(8) アノード／正孔輸送ゾーン（アントラセン誘導体化合物）／発光ゾーン（アントラセン誘導体化合物＋トリアジン誘導体化合物）／電子輸送ゾーン（トリアジン誘導体化合物）／カソード

(9) アノード／正孔輸送ゾーン（アントラセン誘導体化合物）／発光ゾーン（アントラセン誘導体化合物＋トリアジン誘導体化合物）／電子輸送ゾーン（非アントラセンかつ非トリアジン誘導体化合物）／カソード

(10) アノード／正孔輸送ゾーン（アントラセン誘導体化合物）／発光ゾーン（アントラセン誘導体化合物＋トリアジン誘導体化合物）／カソード

(11) アノード／正孔輸送ゾーン（アントラセン誘導体化合物）／発光ゾーン（トリアジン誘導体化合物）／カソード

(12) アノード／正孔輸送ゾーン（アントラセン誘導体化合物）／発光ゾーン（トリアジン誘導体化合物）／電子輸送ゾーン（トリアジン誘導体化合物）／カソード

(13) アノード／正孔輸送ゾーン（アントラセン誘導体化合物）／発光ゾーン（トリアジン誘導体化合物）／電子輸送ゾーン（非アントラセンかつ非トリアジン誘導体化合物）／カソード

(14) アノード／正孔輸送ゾーン（アントラセン誘導体化合物）／発光ゾーン（非アントラセンかつ非トリアジン誘導体化合物）／電子輸送ゾーン（トリアジン誘導体化合物）／カソード。

【0013】

6、7において、アントラセン誘導体化合物＋トリアジン誘導体化合物の層は発光ゾーンの一部であると等しく見られる。

1～7において、配置は必要によりアントラセン誘導体化合物及び／又は非アントラセンかつ非トリアジン誘導体化合物を含んでもよい正孔輸送ゾーン（アノードに隣接）を更に含んでもよい。

8～14において、配置は必要により正孔輸送ゾーン（アノードに隣接）中に非アントラセンかつ非トリアジン誘導体化合物を更に含んでもよい。

アントラセン誘導体化合物及びトリアジン誘導体化合物を含む発光領域は一層、二層、三層又はそれより多い層であってもよい。例えば、単層発光領域について、アントラセン誘導体化合物及びトリアジン誘導体化合物は二つの機能性領域：発光ゾーン（例えば、アントラセン誘導体化合物＋トリアジン誘導体化合物）及び電子輸送ゾーン（例えば、アントラセン誘導体化合物＋トリアジン誘導体化合物）が生じられるように層の厚さを横切って種々の濃度で付着でき、この場合、電子輸送ゾーン中のアントラセン誘導体化合物の濃度

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は、例えば、発光ゾーン中よりも小さく、又は、必要により、電子輸送ゾーンから完全に不在である。実施態様において、アントラセン誘導体化合物及びトリアジン誘導体化合物の混合物をその中で一定濃度で含む単層発光体が提供される。多層発光領域は、例えば、下記のもの：電荷輸送層と接触する発光層；及び正孔輸送層と電子輸送層の間の発光層を含んでもよい。

【0014】

発光ゾーンは単一アントラセン誘導体化合物、又は二種以上のアントラセン誘導体化合物の混合物を含んでもよい。二種以上のアントラセン誘導体化合物の混合物が使用される場合、アントラセン誘導体化合物はあらゆる好適な重量比、例えば、等しい量又は等しくない量で存在してもよい。混合物中の一種の化合物は、例えば、0.1重量%から99.9重量%までの範囲の量で存在してもよく、残部はその他の一種以上の化合物である。一種以上のアントラセン誘導体化合物に加えて、電荷輸送物質は発光ゾーンを基準として、例えば、0重量%から約95重量%までの範囲の濃度で発光ゾーン中に存在してもよく、残部は発光ゾーンを基準として100重量%から約5重量%までの範囲の濃度の一種以上のアントラセン誘導体化合物である。

また、発光ゾーンは単一トリアジン誘導体化合物、又は二種以上のトリアジン誘導体化合物の混合物を含んでもよい。二種以上のトリアジン誘導体化合物の混合物が使用される場合、トリアジン誘導体化合物はあらゆる好適な重量比、例えば、等しい量又は等しくない量で存在してもよい。混合物中の一種の化合物は、例えば、0.1重量%から99.9重量%までの範囲の量で存在してもよく、残部はその他の一種以上の化合物である。一種以上のトリアジン誘導体化合物に加えて、電荷輸送物質は発光ゾーンを基準として、例えば、0重量%から約95重量%までの範囲の濃度で発光ゾーン中に存在してもよく、残部は発光ゾーンを基準として100重量%から約5重量%までの範囲の濃度の一種以上のトリアジン誘導体化合物である。

【0015】

また、発光ゾーンは一種以上のアントラセン誘導体化合物及び一種以上のトリアジン誘導体の混合物を含んでもよい。一種以上のアントラセン誘導体化合物及び一種以上のトリアジン誘導体化合物の二種以上の混合物が使用される場合、一種以上のアントラセン誘導体化合物及び一種以上のトリアジン誘導体化合物の夫々はあらゆる好適な重量比、例えば、等しい量又は等しくない量で存在してもよい。混合物中の一種の化合物は、例えば、0.1重量%から99.9重量%までの範囲の量で存在してもよく、残部はその他の一種以上の化合物である。一種以上のアントラセン誘導体化合物及び一種以上のトリアジン誘導体化合物に加えて、電荷輸送物質は発光ゾーンを基準として、例えば、0重量%から約95重量%までの範囲の濃度で発光ゾーン中に存在してもよく、残部は発光ゾーンを基準として100重量%から約5重量%までの範囲の濃度の一種以上のアントラセン誘導体化合物及び一種以上のトリアジン誘導体化合物である。

実施態様において、発光ゾーンはあらゆる好適な重量比、例えば、等しい量又は等しくない量で一種以上の非アントラセンかつ非トリアジン誘導体化合物を含んでもよい。これらの一種以上の非アントラセンかつ非トリアジン誘導体化合物はこのような一種以上の非アントラセンかつ非トリアジン誘導体化合物を含まない発光ゾーンと較べて放出された光の色の強さ又は色の純度に影響するために発光ゾーンに添加されてもよい。本発明の実施態様において、青色放出OLEDが製造される。別の実施態様において、別の色を発するOLEDが発光領域中の適当な物質の使用により、例えば、一種以上の非アントラセンかつ非トリアジン誘導体化合物を発光ゾーンに添加して青色を別の色に変化することにより製造されてもよい。

【0016】

電荷輸送ゾーン（正孔輸送ゾーン又は電子輸送ゾーンを問わない）は単一電荷輸送物質又はあらゆる好適な重量比、例えば、等しい量又は等しくない量の二種以上の電荷輸送物質の混合物を含む。混合物中の一種の化合物は、例えば、0.1重量%から99.9重量%までの範囲の量で存在してもよく、残部はその他の一種以上の化合物である。電荷輸送ゾ

ーンは一種以上のアントラセン誘導体化合物、一種以上のトリアジン誘導体化合物、一種以上の非アントラセンかつ非トリアジン化合物、又はこれらのあらゆる混合物を含んでもよい。

OLEDの層は見る者に面しているOLEDの面に依りて透明又は不透明であってもよい。例示の物質が本発明のOLEDの構築に説明されるであろう。

実質的に透明な支持体は、例えば、ポリマー成分、ガラス、石英等を含む種々の好適な材料を含んでもよい。好適なポリマー成分として、ポリエステル、例えば、マイラー（登録商標）、ポリカーボネート、ポリアクリレート、ポリメタクリレート、ポリスルホン等が挙げられるが、これらに限定されない。その他の支持体材料がまた選ばれてもよい。

【0017】

支持体は約10マイクロメートルから約5,000マイクロメートルまで、更に特別には約25マイクロメートルから約1,000マイクロメートルまでの厚さを有してもよい。アノードは好適な正電荷注入材料、例えば、インジウムスズ酸化物（ITO）、シリコン、スズ酸化物、及び約4eVから約6eVまでの範囲の仕事関数を有する金属、例えば、金、白金、及びパラジウムを含んでもよい。アノードに適したその他の材料として、例えば、約4eV以上、特に約4eVから約6eVまでの仕事関数を有する導電性カーボン、元共役ポリマー、例えば、ポリアニリン、ポリチオフェン、ポリピロール等が挙げられるが、これらに限定されない。実質的に透明なアノードは、例えば、インジウムスズ酸化物（ITO）、約4eVから約6eVまでの範囲の仕事関数を有する金属、例えば、金、パラジウム等を含み、例えば、約10Åから約200Åまで、特に、約30Åから約100Åまでの厚さを有する、非常に薄い実質的に透明な金属層を含んでもよい。アノードの厚さは約10Åから約50,000Åまでの範囲であってもよく、好ましい範囲はアノード材料の電気定数及び光学定数に依存する。アノードの厚さの一つの例示の範囲は約300Åから約3,000Åまでである。

【0018】

カソードは、例えば、約4eVから約6eVまでの仕事関数を有する高仕事関数成分、例えば、金属、又は、例えば、約2eVから約4eVまでの仕事関数を有する低仕事関数成分、例えば、金属を含む、あらゆる好適な電子注入材料、例えば、金属を含んでもよい。カソードは低仕事関数（約4eV未満）金属と少なくとも一種のその他の金属の組み合わせを含んでもよい。低仕事関数金属対第二又はその他の金属の有効比率は約0.1重量%未満から約99.9重量%までである。低仕事関数金属の例示の例として、アルカリ金属、例えば、リチウム又はナトリウム；2A族又はアルカリ土類金属、例えば、ベリリウム、マグネシウム、カルシウム又はバリウム；並びに稀土類金属及びアクチニド族金属を含むIII族金属、例えば、スカンジウム、イットリウム、ランタン、セリウム、ユーロビウム、テルビウム又はアクチニウムが挙げられるが、これらに限定されない。リチウム、マグネシウム及びカルシウムが好ましい低仕事関数金属である。Mg-Ag合金カソードが実施態様においてカソードを形成するのに好ましいカソード材料である。その他の特別なカソードは金属-有機混合層（MOML）を含む。カソードはその他の高仕事関数金属、例えば、アルミニウム及びインジウムとのリチウム合金から形成し得る。

【0019】

実質的に透明なカソードは約2eVから約4eVまでの範囲の仕事関数を有する金属、例えば、Mg、Ag、Al、Ca、In、Li及びそれらの合金、例えば、約80～95体積%のMg及び約20～約5体積%のAgを含むMg:Ag合金、及び、例えば、約90～99体積%のAl、及び約10～約1体積%のLiを含むLi:Al合金等を含み、例えば、約10Åから約200Åまで、特に、約30Åから約100Åまでの厚さを有する非常に薄い実質的に透明な金属層を含んでもよい。

カソードの厚さは、例えば、約10ナノメートルから約1,000ナノメートルまでの範囲であってもよい。

本OLEDに使用されるアノード及びカソードは夫々単層であってもよく、又は2層、3層もしくはそれより多い層を含んでもよい。例えば、電極は電荷注入層（即ち、電子注入

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層又は正孔注入層)及びキャッピング層を含んでもよい。しかしながら、実施態様において、電荷注入層は電極とは異なると考えられてもよい。電子注入層は約2 eVから約4 eVまでの範囲の仕事関数を有する金属、例えば、Mg、Ag、Al、Ca、In、Li及びこれらの合金、例えば、約80～95体積%のMg及び約20～約5体積%のAgを含むMg:Ag合金、及び、例えば、約90～99体積%のAl、及び約10～約1体積%のLiを含むLi:Al合金等を含み、例えば、約10Åから約200Åまで、特に、約30Åから約100Åまでの厚さを有する非常に薄い実質的に透明な金属層を含んでもよい。電子注入層はまた米国特許第5,457,565号、同第5,608,287号及び同第5,739,685号に記載されたような酸化物材料又はアルカリ金属化合物の如き非常に薄い絶縁材料を含んでもよい。

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【0020】

正孔注入層は好適な正電荷注入材料、例えば、インジウムスズ酸化物(ITO)、シリコン、スズ酸化物、及び約4 eVから約6 eVまでの範囲の仕事関数を有する金属、例えば、金、白金、及びパラジウムを含んでもよい。正孔注入層に適したその他の材料として、例えば、約4 eV以上、特に約4 eVから約6 eVまでの仕事関数を有する、導電性カーボン、π共役ポリマー、例えば、ポリアニリン、ポリチオフェン、ポリピロール等が挙げられるが、これらに限定されない。実質的に透明な正孔注入材料は約4 eVから約6 eVまでの範囲の仕事関数を有する金属、例えば、金、パラジウム等を含み、例えば、約10Åから約200Åまで、特に、約30Åから約100Åまでの厚さを有する、非常に薄い実質的に透明な金属層を含んでもよい。正孔注入層の付加的な好適な形態が米国特許第4,885,211号及び同第5,703,436号に開示されている。

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アノード及び/又はカソードのキャッピング層は熱安定性を増大し、環境安定性を増大し、かつ/又は或る種のその他の方法で有機発光装置の性能を改良するために含まれてもよい。有機発光装置の熱安定性を増大するのに使用し得るキャッピング層の例はSiO、SiO₂、又はこれらの混合物を含む層である。有機発光装置の環境安定性を増大するのに使用し得るキャッピング層の例は安定な金属、例えば、Ag、Al、In、又はAuを含む層である。有機発光装置の環境安定性を増大するのに使用し得るキャッピング層の別の例は、例えば、米国特許第5,059,861号に記載されたような低仕事関数金属を含む層である。キャッピング層の厚さは、例えば、約20ナノメートルから約5,000ナノメートルまで、又は約50ナノメートルから500ナノメートルまでの範囲であってもよい。

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【0021】

緩衝層は或る種の正孔注入特性及び輸送特性を有する材料を含んでもよく、装置性能が改良されるように選ばれる。緩衝層中に利用し得る好適な材料として、半導体有機材料、例えば、米国特許第4,356,429号に開示された1,10,15,20-テトラフェニル-21H,23H-ポルフィリン銅(II)のようなポルフィリン誘導体；銅フタロシアニン、銅テトラメチルフタロシアニン；亜鉛フタロシアニン；酸化チタンフタロシアニン；マグネシウムフタロシアニン等が挙げられ、銅フタロシアニンが一つの好ましい例である。これらの材料及びその他の好適な材料の混合物がまた使用し得る。緩衝層中に利用し得るその他の好適な材料として、半導体かつ絶縁性の金属化合物、例えば、MgO、Al₂O₃、BeO、BaO、AgO、SrO、SiO、SiO₂、ZrO₂、CaO、CS₂O、Rb₂O、Li₂O、K₂O及びNa₂Oのような金属酸化物；並びにLiF、KCl、NaCl、CsCl、CSF及びKFのようなハロゲン化金属が挙げられる。緩衝層は約1nmから約100nmまでしくは約5nmから約25nmまで又は約1nmから約5nmまでの範囲の厚さを有し得る。

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例示のアントラセン誘導体化合物として、EP 1009044 A2の化合物、一般構造式I(A)(1)～I(A)(11)のアントラセン誘導体化合物が挙げられる。

【0022】

式中、置換基R¹、R²、R³、R⁴、R⁵及びR⁶は夫々独立に水素、1～24個の炭素原子のアルキル、1～9個の炭素原子のアルコキシ、トリフェニルシリル、6～20個

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の炭素原子のアリール（これは必要により置換されていてもよい）、5～24個の炭素原子のヘテロアリール（これは必要により置換されていてもよい）、ハロゲン、例えば、フッ素、塩素、臭素、及びシアノ基からなる群から選ばれる。ヘテロアリール中のヘテロ原子は、例えば、窒素、硫黄、又は酸素であってもよい。アリール及びヘテロアリールは必要により同じ又は異なる部分、例えば、下記の部分：1～9個の炭素原子のアルキル、1～9個の炭素原子のアルコキシ、ハロゲン、例えば、フッ素、塩素、臭素、及びシアノ基等により1回、2回又はそれより多い回数で置換されていてもよい。

【0023】

その他の例示のアントラセン誘導体化合物として、米国特許第5,972,247号に開示されたものが挙げられ、そこに一般構造式I(B)のアントラセン誘導体化合物が開示されている。

式中、置換基 R^7 、 R^8 、 R^9 、及び R^{10} は夫々独立に

群1：水素、又は1～24個の炭素原子のアルキル；

群2：6～20個の炭素原子のアリール（これは必要により置換されていてもよい）；

群3：ナフチル、アントラセニル、ピレニル、又はペリレニルの縮合芳香族環を完成するのに必要な炭素原子；

群4：5～24個の炭素原子のヘテロアリール（これは必要により置換されていてもよい）；

群5：フリル、チエニル、ピリジル、又はキノリニルの縮合ヘテロ芳香族環；

群6：1～24個の炭素原子のアルコキシ基、アミノ基、アルキルアミノ基、又はアリールアミノ基；及び

群7：フッ素、塩素、臭素又はシアノ

からなる群から選ばれる。

ヘテロアリール中のヘテロ原子は、例えば、窒素、硫黄、又は酸素であってもよい。アリール及びヘテロアリールは必要により同じ又は異なる部分、例えば、下記の部分：1～9個の炭素原子のアルキル、1～9個の炭素原子のアルコキシ、ハロゲン、例えば、フッ素、塩素、臭素、及びシアノ基等により1回、2回又はそれより多い回数で置換されていてもよい。

【0024】

更にその他の例示のアントラセン誘導体化合物として、米国特許第5,935,721号に開示されたもの、一般構造式I(C)のアントラセン誘導体化合物が挙げられる。

式中、置換基 R^{11} 、 R^{12} 、 R^{13} 、及び R^{14} は夫々独立に

群1：水素、又は1～24個の炭素原子のアルキル；

群2：6～20個の炭素原子のアリール（これは必要により置換されていてもよい）；

群3：ナフチル、アントラセニル、ピレニル、又はペリレニルの縮合芳香族環を完成するのに必要な炭素原子；

群4：5～24個の炭素原子のヘテロアリール（これは必要により置換されていてもよい）、フリル、チエニル、ピリジル、キノリニルの縮合ヘテロ芳香族環、及びその他の複素環系を完成するのに必要な炭素原子；

群5：1～24個の炭素原子のアルコキシ基、アミノ基、アルキルアミノ基、又はアリールアミノ基；及び

群6：フッ素、塩素、臭素又はシアノ

からなる群から選ばれる。

ヘテロアリール中のヘテロ原子は、例えば、窒素、硫黄、又は酸素であってもよい。アリール及びヘテロアリールは必要により同じ又は異なる部分、例えば、下記の部分：1～9個の炭素原子のアルキル、1～9個の炭素原子のアルコキシ、ハロゲン、例えば、フッ素、塩素、臭素、及びシアノ基等により1回、2回又はそれより多い回数で置換されていてもよい。

一般式I(C)のこれらのアントラセン誘導体化合物の一つの好ましい例は9,10-ジ-（2-ナフチル）アントラセン誘導体化合物である。

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【0025】

アントラセン誘導体化合物の更に別の例として、式I(D)により示される化合物が挙げられる。

式中、 R^{15} 及び R^{16} は独立に水素、1～約6個の炭素原子を有するアルキル基、約6～約30個の炭素原子を有するアリール基からなる群から選ばれる。 R^{15} 及び R^{16} に関する置換基の特別な例は水素、メチル、セトリセーブチル、フェニル、ナフチル等である。 X 及び Y は独立に水素、例えば、1～約6個の炭素原子を有するアルキル基、約6個～約30個の炭素原子を有するアリール基、例えば、1～約6個の炭素原子を有するアルコキシ基、ハロゲン、シアノ基等からなる群から選ばれる。 X 及び Y に関する置換基の特別な例は水素、メチル、セトリセーブチル、セトリセーブトキシ等である。

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【0026】

トリアジン誘導体化合物の例として、米国特許第6,229,012号、同第6,225,467号及び同第6,057,048号に開示された化合物が挙げられる。例示のトリアジン誘導体化合物は、例えば、式II(A)～II(D)により含まれる。

式中、 A^{r1} 、 A^{r2} 、 A^{r3} 、及び A^{r4} は夫々独立に6～約20個の炭素原子のアリール（これは必要により置換されていてもよい）であり、そのアリールは、例えば、フェニル、スチルベニル、ビフェニリル、ナフチル、ビリジル、及びキノリル等からなる群から選ばれてもよい。アリール基は必要により、例えば、1～約6個の炭素原子を有するアルキル基、例えば、1～約6個の炭素原子を有するアルコキシ基、例えば、1～約3個の炭素原子を有するジアルキルアミノ基、ハロゲン、シアノ基等からなる群から選ばれた置換基により1回、2回又はそれより多い回数で置換されていてもよい。

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R^{17} ～ R^{18} は独立に水素、脂肪族基、例えば、1～約6個の炭素原子を有するアルキル基、例えば、1～約6個の炭素原子を有するアルコキシ基、ハロゲン、例えば、塩素、シアノ基からなる群から選ばれ、

S は $-C(R'R'')$ 、エチレン、 $-S-(R'R'')$ 、酸素原子、硫黄原子等からなる群から選ばれてもよい2価の基であり、 R' 及び R'' は夫々独立に水素原子、1～約10個の炭素原子を含むアルキル基、又は1～約10個の炭素原子を含むアルコキシ基である。

【0027】

発光領域、特に発光ゾーンは、ドーパントとして約0.01重量%から約25重量%まで（発光ゾーンの重量を基準とする）の発光物質を更に含んでもよい。発光領域中で利用し得るドーパント物質の例は蛍光物質、例えば、クマリン、ジシアノメチレンピラン、ポリメチン、オキサベンズアントラン、キサントゲン、ビリリウム、カルボスチル、ベリレン等である。蛍光物質の別の好ましいクラスはキナクリドン染料である。キナクリドン染料の例示の例として、米国特許第5,227,252号、同第5,276,381号及び同第5,593,788号に開示されたようなキナクリドン、2-メチルキナクリドン、2-9-ジメチルキナクリドン、2-クロロキナクリドン、2-フルオロキナクリドン、1,2-ベンゾキナクリドン、 N,N' -ジメチルキナクリドン、 N,N' -ジメチル-2-9-ジメチルキナクリドン、 N,N' -ジメチル-2-クロロキナクリドン、 N,N' -ジメチル-2-フルオロキナクリドン、 N,N' -ジメチル-1,2-ベンゾキナクリドン等が挙げられる。使用し得る蛍光物質の別のクラスは縮合環蛍光染料である。例示の好適な縮合環蛍光染料として、米国特許第3,172,862号に開示されたようなベリレン、ルブレネン、アントラセン、コロネン、フェナントレネン、ピレン等が挙げられる。また、蛍光物質として、米国特許第4,356,429号及び同第5,516,577号に開示されたようなプタジエン、例えば、1,4-ジフェニルプタジエン及びテトラフェニルプタジエン、並びにスチルベン等が挙げられる。使用し得る蛍光物質のその他の例は米国特許第5,601,903号に開示されたものである。

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【0028】

更に、発光領域中で利用し得る発光ドーパントは米国特許第5,935,720号に開示

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された蛍光染料、例えば、4-(ジシアノメチレン)-2-イソプロピル-6-(1, 7, 7-テトラメチルジフルオロリジル-9-エンイル)-4H-ピラン(DCJTB)；ランタニド金属キレート錯体、例えば、トリス(アセチルアセトネート)(フェナントロリン)テルビウム、トリス(アセチルアセトネート)(フェナントロリン)ユーロビウム、及びトリス(テノイルトリスフルオロアセトネート)(フェナントロリン)ユーロビウム、及びKidoら、"ランタニド錯体を使用する白色光放出有機電気発光装置"、Jpn. J. Appl. Phys., 35巻、L894-L896頁(1996)に開示されたもの；並びにリン光物質、例えば、強いスピン軌道カップリングをもたらし重金属原子を含む有機金属化合物、例えば、BaIdora、"有機電気発光装置からの高度に有効な有機リン光放出"、Leshchetskio Nature, 395巻、151-154(1998)に開示されたものである。好ましい例として、2, 3, 7, 8, 12, 13, 17, 18-オクタエチル-21H23H-フォルピン白金(II)(PTEP)及びfacトリス(2-フェニルピリジン)イリジウム(Ir(PPh₃))が挙げられる。

【0029】

トリアジン誘導体物質及びアントラセン誘導体物質に加えて、発光領域、特に正孔輸送ゾーンはまた正孔輸送特性を有する一種以上のその他の物質を含んでもよい。発光領域中で利用し得る正孔輸送物質の例として、米国特許第5, 728, 801号に開示されたようなポリピロール、ポリアニリン、ポリ(フェニレンビニレン)、ポリチオフェン、ポリアリールアミン、及びそれらの誘導体、並びに既知の半導体有機物質；ポルフィリン誘導体、例えば、米国特許第4, 356, 429号に開示された1, 10, 15, 20-テトラフェニル-21H, 23H-ポルフィリン銅(II)；銅フタロシアニン、銅テトラメチルフタロシアニン；亜鉛フタロシアニン；チタン酸化物フタロシアニン；マグネシウムフタロシアニン等が挙げられる。

【0030】

発光領域中で利用し得る正孔輸送物質の特別なクラスは芳香族三級アミン、例えば、米国特許第4, 539, 507号に開示されたものである。好適な例示の芳香族三級アミンとして、ビス(4-ジメチルアミノ-2-メチルフェニル)フェニルメタン、N, N, N-トリ(ポートリル)アミン、1, 1-ビス(4-ジ-ポートリルアミノフェニル)シクロヘキサン、1, 1-ビス(4-ジ-ポートリルアミノフェニル)-4-フェニルシクロヘキサン、N, N'-ジフェニル-N, N'-ビス(3-メチルフェニル)-1, 1'-ビフェニル-4, 4'-ジアミン、N, N'-ジフェニル-N, N'-ビス(3-メチルフェニル)-1, 1'-ビフェニル-4, 4'-ジアミン、N, N'-ジフェニル-N, N'-ビス(4-メトキシフェニル)-1, 1'-ビフェニル-4, 4'-ジアミン、N, N, N', N'-テトラ-ポートリル-1, 1'-ビフェニル-4, 4'-ジアミン、N, N'-ジ-1-ナフチル-N, N'-ジフェニル-1, 1'-ビフェニル-4, 4'-ジアミン、N, N'-ビス(4-ビフェニル)-N, N'-ジフェニルベンジジン(ビフェニルTPD)、これらの混合物等が挙げられるが、これらに限定されない。発光領域中で使用し得る三級芳香族アミンの好ましいクラスはナフチル置換ベンジジン誘導体、例えば、N, N'-ジ(ナフタレン-1-イル)-N, N'-ジフェニルベンジジン(NPD)である。芳香族三級アミンの別のクラスは多核芳香族アミンである。これらの多核芳香族アミンの例として、N, N-ビス-[4'-(N-フェニル-N-m-トリルアミノ)-4-ビフェニル]アニリン、N, N-ビス-[4'-(N-フェニル-N-m-トリルアミノ)-4-ビフェニル]-m-トリルイジン、N, N-ビス-[4'-(N-フェニル-N-m-トリルアミノ)-4-ビフェニル]-ポートリルイジン、

【0031】

N, N-ビス-[4'-(N-フェニル-N-ポートリルアミノ)-4-ビフェニル]アニリン、N, N-ビス-[4'-(N-フェニル-N-ポートリルアミノ)-4-ビフェニル]-m-トリルイジン、N, N-ビス-[4'-(N-フェニル-N-ポートリルアミノ)-4-ビフェニル]-ポートリルイジン、N, N-ビス-[4'-(N-フェニル-N-ポートリルアミノ)-4-ビフェニル]-ポートリルイジン、

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ル-N-P-クロロフェニルアミノ)-4-ビフェニリル]-m-トリジン、N、N-ビス-[4'-(N-フェニル-N-m-クロロフェニルアミノ)-4-ビフェニリル]-m-トリジン、N、N-ビス-[4'-(N-フェニル-N-m-クロロフェニルアミノ)-4-ビフェニリル]-p-トリジン、N、N-ビス-[4'-(N-フェニル-N-m-トリルアミノ)-4-ビフェニリル]-p-クロロアニリン、N、N-ビス-[4'-(N-フェニル-N-p-トリルアミノ)-4-ビフェニリル]-m-クロロアニリン、N、N-ビス-[4'-(N-フェニル-N-m-トリルアミノ)-4-ビフェニリル]-1-アミノナフタレン、これらの混合物等、4, 4'-ビス(9-カルバゾリル)-1, 1'-ビフェニル化合物、例えば、4, 4'-ビス(9-カルバゾリル)-1, 1'-ビフェニル及び4, 4'-ビス(8-メチル-9-カルバゾリル)-1, 1'-ビフェニル等が挙げられるが、これらに限定されない。

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【0032】

発光領域中に使用し得る正孔輸送物質の特別なクラスは米国特許第5, 942, 340号及び同第5, 952, 115号に開示されたもの、例えば、5, 11-ジナフチル-5, 11-ジヒドロインドロ[3, 2-b]カルバゾール、及び2, 8-ジメチル-5, 11-ジナフチル-5, 11-ジヒドロインドロ[3, 2-b]カルバゾール；N, N, N', N'-テトラアリアルベンジジン（アリアルはフェニル、m-トリル、p-トリル、m-メトキシフェニル、p-メトキシフェニル、1-ナフチル、2-ナフチル等から選ばれてもよい）である。N, N, N', N'-テトラアリアルベンジジンの例示の例はN, N'-ジ-1-ナフチル-N, N'-ジフェニル-1, 1'-ビフェニル-4, 4'-ジアミン（これが更に好ましい）、N, N'-ビス(8-メチルフェニル)-N, N'-ジフェニル-1, 1'-ビフェニル-4, 4'-ジアミン、N, N'-ビス(8-メトキシフェニル)-N, N'-ジフェニル-1, 1'-ビフェニル-4, 4'-ジアミン等である。

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【0033】

実施態様において、発光領域は所望の性質、例えば、電子輸送特性及び／又は発光特性を有する一種以上の非アントラセンかつ非トリアジン誘導体化合物を含んでもよい。実施態様において、幾つかの下記の例示の非アントラセンかつ非トリアジン誘導体化合物は電子輸送特性及び／又は発光特性を有してもよく、こゝして発光領域（例えば、発光ゾーン及び／又は電子輸送ゾーン）中で有益であるかもしれない：ポリフルオレン、例えば、ポリ(9, 9-ジ-*n*-オクチルフルオレン-2, 7-ジイル)、ポリ(2, 8-(6, 7, 12, 12-テトラアルキルインデノフルオレン)及びフルオレンを含むコポリマー、例えば、Berniusら、有機発光物質及び装置に関するSPIE会議の予稿集III, Denver, Colorado, 1999年7月, 3797巻, 129頁に開示されたようなフルオレン-アミンコポリマー。

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その他の好適な非アントラセンかつ非トリアジン誘導体化合物として、米国特許第4, 539, 507号、同第5, 151, 629号、同第5, 150, 006号、同第5, 141, 671号及び同第5, 846, 666号に開示されたような金属オキシノイドが挙げられる。例示の特別な例として、トリス(8-ヒドロキシキノレート)アルミニウム(AIq₃)、ビス(8-ヒドロキシキノレート)-(4-フェニルフェノレート)アルミニウム(BaIq)が挙げられる。その他の例として、トリス(8-ヒドロキシキノレート)ガリウム、ビス(8-ヒドロキシキノレート)マグネシウム、ビス(8-ヒドロキシキノレート)亜鉛、トリス(5-メチル-8-ヒドロキシキノレート)アルミニウム、トリス(7-フロピル-8-キノレート)アルミニウム、ビス[ペンゾ{f}-8-キノレート]亜鉛、ビス(10-ヒドロキシペンゾ{h}キノレート)ベリリウム等が挙げられる。

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【0034】

非アントラセンかつ非トリアジン誘導体化合物の別の好適なクラスはスチルベン誘導体、例えば、米国特許第5, 516, 577号に開示されたものである。非アントラセンかつ非トリアジン誘導体化合物の更なる例は米国特許第5, 846, 666号（その開示が参

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考として本明細書に完全に含まれる)に示された、金属チオキシノイド化合物、例えば、ビス(8-キノリンチオラート)亜鉛、ビス(8-キノリンチオラート)カドミウム、トリス(8-キノリンチオラート)ガリウム、トリス(8-キノリンチオラート)インジウム、ビス(5-メチルキノリンチオラート)亜鉛、トリス(5-メチルキノリンチオラート)ガリウム、トリス(5-メチルキノリンチオラート)インジウム、ビス(5-メチルキノリンチオラート)カドミウム、ビス(8-メチルキノリンチオラート)カドミウム、ビス(5-メチルキノリンチオラート)亜鉛、ビス〔ベンゾ{f}-8-キノリンチオラート〕亜鉛、ビス〔3-メチルベンゾ{f}-8-キノリンチオラート〕亜鉛、ビス〔3,7-ジメチルベンゾ{f}-8-キノリンチオラート〕亜鉛等の金属チオキシノイド化合物である。特別な非アントラセンかつ非トリアジン誘導体化合物はビス(8-キノリンチオラート)亜鉛、ビス(8-キノリンチオラート)カドミウム、トリス(8-キノリンチオラート)ガリウム、トリス(8-キノリンチオラート)インジウム及びビス〔ベンゾ{f}-8-キノリンチオラート〕亜鉛である。

【0035】

その他の好適な非アントラセンかつ非トリアジン誘導体化合物は含まれた米国特許第5,925,472号に開示されたオキサジアゾール金属キレートであり、これらの物質として、ビス〔2-(2-ヒドロキシフェニル)-5-フェニル-1,3,4-オキサジアゾレート〕亜鉛、ビス〔2-(2-ヒドロキシフェニル)-5-フェニル-1,3,4-オキサジアゾレート〕ベリリウム、ビス〔2-(2-ヒドロキシフェニル)-5-(1-ナフチル)-1,3,4-オキサジアゾレート〕亜鉛、ビス〔2-(2-ヒドロキシフェニル)-5-(1-ナフチル)-1,3,4-オキサジアゾレート〕ベリリウム、ビス〔5-ビフェニル-2-(2-ヒドロキシフェニル)-1,3,4-オキサジアゾレート〕亜鉛、ビス〔5-ビフェニル-2-(2-ヒドロキシフェニル)-1,3,4-オキサジアゾレート〕ベリリウム、ビス(2-ヒドロキシフェニル)-5-フェニル-1,3,4-オキサジアゾレート〕リチウム、ビス〔2-(2-ヒドロキシフェニル)-5-ポートリル-1,3,4-オキサジアゾレート〕亜鉛、ビス〔2-(2-ヒドロキシフェニル)-5-ポートリル-1,3,4-オキサジアゾレート〕ベリリウム、ビス〔5-(p-セプトチルフェニル)-2-(2-ヒドロキシフェニル)-1,3,4-オキサジアゾレート〕亜鉛、ビス〔5-(p-セプトチルフェニル)-2-(2-ヒドロキシフェニル)-1,3,4-オキサジアゾレート〕ベリリウム、ビス〔2-(2-ヒドロキシフェニル)-5-(3-フルオロフェニル)-1,3,4-オキサジアゾレート〕亜鉛、ビス〔2-(2-ヒドロキシフェニル)-5-(4-フルオロフェニル)-1,3,4-オキサジアゾレート〕亜鉛、ビス〔2-(2-ヒドロキシフェニル)-5-(4-フルオロフェニル)-1,3,4-オキサジアゾレート〕ベリリウム、ビス〔5-(4-クロロフェニル)-2-(2-ヒドロキシフェニル)-1,3,4-オキサジアゾレート〕亜鉛、ビス〔2-(2-ヒドロキシフェニル)-5-(4-メトキシフェニル)-1,3,4-オキサジアゾレート〕亜鉛、ビス〔2-(2-ヒドロキシ-4-メチルフェニル)-5-フェニル-1,3,4-オキサジアゾレート〕亜鉛、

【0036】

ビス〔2- α -(2-ヒドロキシナフチル)-5-フェニル-1,3,4-オキサジアゾレート〕亜鉛、ビス〔2-(2-ヒドロキシフェニル)-5-p-ヒリジル-1,3,4-オキサジアゾレート〕亜鉛、ビス〔2-(2-ヒドロキシフェニル)-5-p-ヒリジル-1,3,4-オキサジアゾレート〕ベリリウム、ビス〔2-(2-ヒドロキシフェニル)-5-(2-チオフェニル)-1,3,4-オキサジアゾレート〕亜鉛、ビス〔2-(2-ヒドロキシフェニル)-5-フェニル-1,3,4-チアジアゾレート〕亜鉛、ビス〔2-(2-ヒドロキシフェニル)-5-フェニル-1,3,4-チアジアゾレート〕ベリリウム、ビス〔2-(2-ヒドロキシフェニル)-5-(1-ナフチル)-1,3,4-チアジアゾレート〕亜鉛、及びビス〔2-(2-ヒドロキシフェニル)-5-(1-ナフチル)-1,3,4-チアジアゾレート〕ベリリウム等が挙げられる。非アントラセンかつ非トリアジン誘導体化合物の別の好適なクラスはキノリン、例えば、1,4-ビス

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(4-フェニルキノリン-2-イル)ベンゼン、4,4'-ビス(4-フェニルキノリン-2-イル)-1,1'-ビフェニル(TA)である。

【0037】

発光領域が一種以上の有機電気発光物質に加えて一種以上の正孔輸送物質及び／又は一種以上の電子輸送物質を含む実施態様において、有機電気発光物質、一種以上の正孔輸送物質、及び／又は一種以上の電子輸送物質は別々の層、例えば、米国特許第4,589,507号、同第4,720,432号及び同第4,769,292号に開示されたOLED中で生成でき、又は同じ層中で生成されて2種以上の物質の混合領域、例えば、米国特許第5,853,905号、同第5,925,980号、同第6,130,001号、同第6,114,055号、同第6,392,250号、同第6,392,339号に開示されたOLEDを形成し得る。

発光領域の厚さは、例えば、約10Åから約10,000Åまで、典型的には約200Åから約2,000Åまで、特に約500Åから約1,500Åまで変化し得る。発光領域が二つ以上の層を含む実施態様において、夫々の層の厚さは、例えば、約10Åから約5,000Åまで、典型的には約50Åから約2,000Åまで、特に約100Åから約1,500Åまでであってもよい。

【0038】

OLEDの夫々の層は層の厚さを横切って一般に一様又は非一様の組成を有してもよく、この場合、夫々の層は一種の物質又は物質の混合物を完全に含む。

OLEDはあらゆる好適な薄膜形成技術、典型的には、スピン被覆又は真空中の熱蒸発による付着を使用して所望の層を支持体上に連続的に形成することにより加工し得る。有機発光装置の加工及び操作に関する更なる詳細が、例えば、米国特許第4,589,507号及び同第4,769,292号に開示されている。

本発明の有機発光装置はその他の青色放出OLED、例えば、放出物質としてのアントラセン誘導体化合物及び電子輸送物質としてのキノリン型金属キレート誘導体化合物(これはトリアジン誘導体化合物ではない)を含むOLEDと較べて、改良された性能、例えば、一層高い操作安定性及び改良された色純度を示し得る。

全ての%及び部数は特に示されない限り重量基準である。

【0039】

【実施例】

実施例1

構造ITOアノード(50nm)/CuPcポルフィリン化合物緩衝層(15nm)/NPB三級芳香族アミン化合物正孔輸送層(30nm)/BH2アントラセン誘導体化合物エミッター層(80nm)/T1トリアジン誘導体化合物電子輸送層(20nm)/Mg:Aqカソード(Mg:Aqの9:1の体積比、200nm)の有機発光装置(本明細書中、装置Aと称される)を加工した。CuPc、NPB、BH2及びT1の分子構造は以下のとおりである。

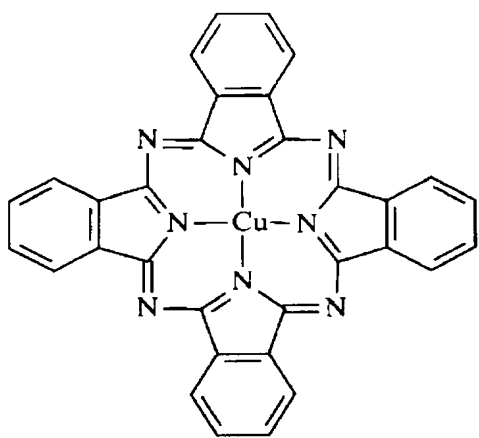
【0040】

【化16】

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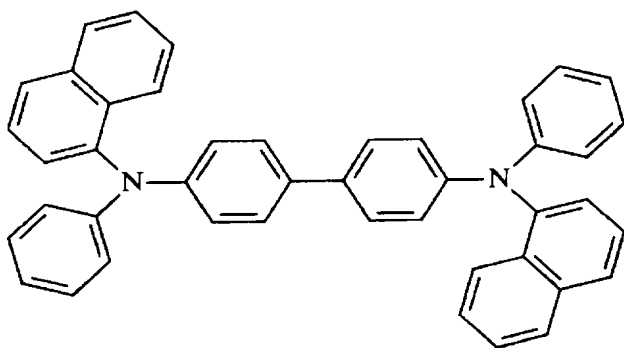
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CuPc

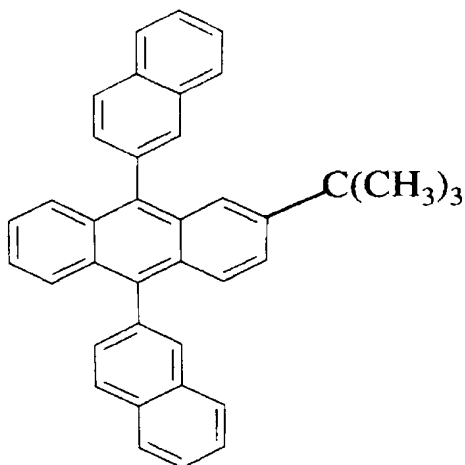


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NPB

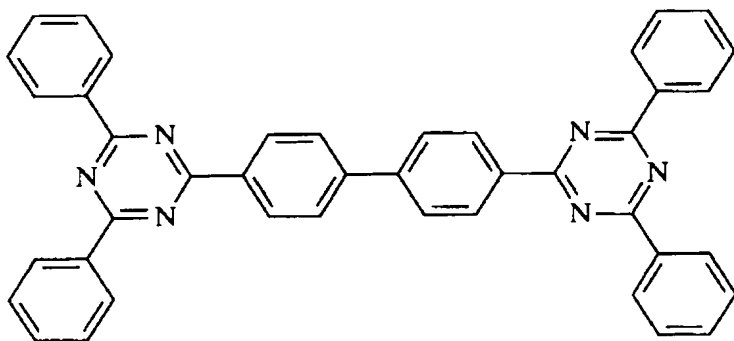
【 0 0 4 1 】
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BH2

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T1

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【0042】

その装置を 5×10^{-6} トルのベース圧力で真空付着により加工し、この場合、全ての有機層、及びカソードをUV-オゾンクリーニングを使用して前洗浄されたITO被覆ガラス支持体上で熱蒸発させた。

電流密度 $=31.25 \text{ mA/cm}^2$ を使用して運転すると、その装置は 240 cd/m^2 の強さの青色放出及びCIEチャートで(0.144, 0.083)座標に相当する色純度を生じた。これらの条件で装置を操作するのに必要とされた運転電圧は8.7ボルトであった。窒素雰囲気下でこの電流密度で60時間の連続操作の後に、放出強さの減衰は初期の強さの1%未満であった。

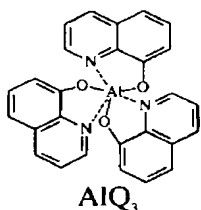
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比較例1 (従来技術)

構造ITOアノード(50nm)/CuPcポルフィリン化合物緩衝層(15nm)/NPB三級芳香族アミン化合物正孔輸送層(80nm)/BH2アントラセン誘導体化合物エミッター層(30nm)/AlQ₃キノリン型金属キレート誘導体化合物電子輸送層(20nm)/Mg:Agカソード(Mg:Agの9:1体積比、200nm)の有機発光装置(本明細書中、装置Bと称される)。AlQ₃の分子構造は

【0048】

【化18】



【0044】

である。

全てのその他の有機化合物の分子構造は先の実施例に示された。

全ての装置を 5×10^{-6} トルのベース圧力で真空付着により加工し、この場合、全ての有機層、及びカソードをUV-オゾンクリーニングを使用して前洗浄されたITO被覆ガラス支持体上で熱蒸発させた。

電流密度 = 31.25 mA/cm^2 を使用して運転すると、その装置は 390 cd/m^2 の強さの青色放出及びCIEチャートで(0.154, 0.114)座標に相当する色純度を生じた。これらの条件で装置を操作するのに必要とされた運転電圧は8.8ボルトであった。窒素雰囲気下でこの電流密度で60時間の連続操作の後に、放出強さの減衰は初期の強さの約10%であった。

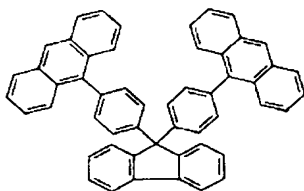
装置A(本発明)及びB(従来技術)の性能を比較すると、装置AはCIE座標、特に、“ γ ”(即ち、第二)座標について一層小さい値から明らかなように一層高い色純度を示したことが明らかである。実際に、装置Aの高い色純度はNTSC工業規格を満足した(青色座標に関するNTSC規格は(0.14, 0.08)である)。明らかに、装置Bはこれらの規格を満足しない。一層高い色純度に加えて、装置Aは装置Bと較べて増大された操作安定性を示した。それ故、本発明の青色放出OLEDは従来技術の装置と較べて潜在的な技術適用について好適である。何とならば、それらが一層良好な性能を与えることができるからである。

実施例2

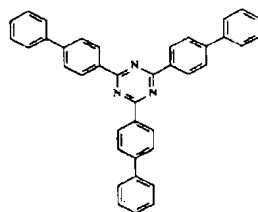
構造ITOアノード(50nm)/NPB三級芳香族アミン化合物正孔輸送層(80nm)/SBPAアントラセン誘導体化合物エミッター層(42nm)/TBTトリアジン誘導体化合物第一電子輸送層(10nm)/AlQ₃キノリン誘導体化合物第二電子輸送層(20nm)/Mg:Agカソード(Mg:Agの9:1体積比、200nm)の有機発光装置(本明細書中、装置Cと称される)を加工した。SBPA及びTBTの分子構造は以下のとおりである。

【0045】

【化19】



SBPA



TBT

【0046】

その他の有機化合物の構造は先の実施例に示された。

全ての装置を 5×10^{-6} トルのベース圧力で真空付着により加工し、この場合、全ての有機層、及びカソードをUV-オゾンクリーニングを使用して前洗浄されたITO被覆ガラス支持体上で熱蒸発させた。

電流密度 = 25.00 mA/cm^2 を使用して運転すると、その装置は 451 cd/m^2 の強さの青色放出及び CIE チャートで (0.158, 0.149) 座標に相当する色純度を生じた。これらの条件で装置を操作するのに必要とされた運転電圧は 10.3 ボルトであった。

【0047】

比較例 2 (従来技術)

構造 ITO アノード (50 nm) / NPB 三級芳香族アミン化合物正孔輸送層 (30 nm) / SBPA アントラセン誘導体化合物エミッター層 (42 nm) / AlQ₃ キノリン誘導体化合物電子輸送層 (20 nm) / Mg : A₉ カソード (Mg : A₉ の 9 : 1 体積比、200 nm) の有機発光装置 (本明細書中、装置 D と称される) を加工した。

有機化合物の構造は先の実施例に示された。

その装置を 5×10^{-6} トルのベース圧力で真空付着により加工し、この場合、全ての有機層、及びカソードを UV-オゾンクリーニングを使用して前洗浄された ITO 被覆ガラス支持体上で熱蒸発させた。

電流密度 = 25.00 mA/cm^2 を使用して運転すると、その装置は 322 cd/m^2 の強さの青色放出及び CIE チャートで (0.189, 0.261) 座標に相当する色純度を生じた。これらの条件で装置を操作するのに必要とされた運転電圧は 9.3 ボルトであった。

装置 C (本発明) 及び D (従来技術) の性能を比較すると、装置 C は CIE 座標、特に、“y” (即ち、第二) 座標について一層小さい値から明らかなように一層高い色純度を示したことが明らかである。

加えて、装置 A 及び C は本発明の実施態様の装置の改良された性能が特定のアントラセン誘導体化合物又は特定のトリアジン誘導体化合物に限定されないことを示す。むしろ、種々のアントラセン誘導体化合物及びトリアジン誘導体化合物の利用は改良された性能を有する有機発光装置を生じるのに使用し得る。

【0048】

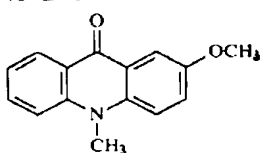
実施例 3

構造 ITO アノード (50 nm) / NPB 三級芳香族アミン化合物正孔輸送層 (30 nm) / アクリドン発光物質 (エミッター層の 1.6 体積%) でドーピングされた SBPA アントラセン誘導体化合物エミッター層 (42 nm) / TBT トリアジン誘導体化合物第一電子輸送層 (10 nm) / AlQ₃ キノリン誘導体化合物第二電子輸送層 (20 nm) / Mg : A₉ カソード (Mg : A₉ の 9 : 1 体積比、200 nm) の有機発光装置 (本明細書中、装置 E と称される) を加工した。

アクリドン青色発光物質の分子構造は

【0049】

【化 20】



【0050】

アクリドン青色発光物質

である。

その他の有機化合物の構造は先の実施例に示された。

その装置を 5×10^{-6} トルのベース圧力で真空付着により加工し、この場合、全ての有機層、及びカソードを UV-オゾンクリーニングを使用して前洗浄された ITO 被覆ガラス支持体上で熱蒸発させた。

電流密度 = 25.00 mA/cm^2 を使用して運転すると、その装置は 410 cd/m^2 の強さの青色放出及び CIE チャートで (0.158, 0.112) 座標に相当する色

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純度を生じた。これらの条件で装置を操作するのに必要とされた運転電圧は10.4ボルトであった。

装置C及びEの色純度座標の比較から、本発明の装置の色純度は青色発光物質を発光ゾーンに添加することにより更に改良し得ることがわかる。

【0051】

実施例4

構造ITOアノード(50nm)/CuPcボルフィリン化合物緩衝層(15nm)/NPB三級芳香族アミン化合物正孔輸送層(30nm)/SBPAを含む発光ゾーンの第一層(2nm)、及びSBPAアントラセン誘導体化合物とTBTトリアジン誘導体化合物の混合物を含む発光ゾーンの第二層(35nm)/TBTトリアジン誘導体化合物第一電子輸送層(8nm)/T1トリアジン誘導体化合物第二電子輸送層(25nm)/Mg:Agカソード(Mg:Agの9:1体積比、200nm)の有機発光装置のグループ(本明細書中、装置F-1~F-11と称される)を加工した。

有機化合物の分子構造は先の実施例に示された。

装置F-1では、発光ゾーン中のSBPA:TBT比は100:0(体積基準)であり、即ち、TBTはなく、装置F-11では、発光ゾーン中のSBPA:TBT比は95:5(体積基準)であり、装置F-111では、発光ゾーン中のSBPA:TBT比は75:25(体積基準)であった。

その装置を 5×10^{-6} トルのベース圧力で真空付着により加工し、この場合、全ての有機層、及びカソードをUV-オゾンクリーニングを使用して前洗浄されたITO被覆ガラス支持体上で熱蒸発させた。

電流密度 $=31.25 \text{ mA/cm}^2$ で100時間の連続運転後に、装置F-1、F-11、及びF-111の強さは初期の強さの40%、30%及び28%だけ低下した。

それ故、発光ゾーン中のアントラセン誘導体化合物及びトリアジン誘導体化合物の混合物の使用は本発明の装置の性能を更に改良し、特に、それらの操作安定性を増大し得ることがわかる。また、或る混合比がその他の比よりも装置操作安定性の更なる増大をもたらし得ることがわかる。

【0052】

実施例5

構造ITOアノード(50nm)/CuPcボルフィリン化合物緩衝層(15nm)/NPB三級芳香族アミン化合物正孔輸送層(50nm)/BH2アントラセン誘導体化合物とNPB三級芳香族アミン電荷輸送化合物の混合物(1:1体積比)発光層(25nm)/BH2アントラセン誘導体化合物を含む電子輸送ゾーンの第一層(5nm)、及びT1トリアジン誘導体化合物を含む電子輸送ゾーンの第二層(20nm)/Mg:Agカソード(Mg:Agの9:1体積比、200nm)の有機発光装置(本明細書中、装置Gと称される)を加工した。

有機化合物の構造は先の実施例に示された。

その装置を 5×10^{-6} トルのベース圧力で真空付着により加工し、この場合、全ての有機層、及びカソードをUV-オゾンクリーニングを使用して前洗浄されたITO被覆ガラス支持体上で熱蒸発させた。

【0053】

電流密度 $=31.25 \text{ mA/cm}^2$ を使用して運転すると、その装置は 200 cd/m^2 の強さの青色放出及びCIEチャートで(0.145, 0.108)座標に相当する色純度を生じた。これらの条件で装置を操作するのに必要とされた運転電圧は8.1ボルトであった。窒素雰囲気下でこの電流密度で600時間の連続運転後に、放出強さの減衰は初期の強さのわずかに約10%であった。

それ故、電子輸送ゾーン中のアントラセン誘導体化合物及びトリアジン誘導体化合物と一緒の発光ゾーン中のアントラセン誘導体化合物と電荷輸送物質の混合物の使用は純粋な青色放出及び優れた操作安定性を有する青色有機発光装置を与え得ることがわかる。

上記実施例から、本発明の青色放出OLEDは潜在的な技術適用に一層適していると結論

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し得る。何とならば、それらがその他の青色放出OLEDと較べて良好な性能を与えることができるからである。

【図面の簡単な説明】

【図1】本発明の第一実施態様の正面図を示す。

【図2】本発明の第二実施態様の正面図を示す。

【図3】本発明の第三実施態様の正面図を示す。

【符号の説明】

110、210、310－OLED

120、320－アノード

220－第一電極

130、230、330－発光領域

140、340－カソード

230A－電荷輸送ゾーン

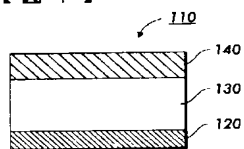
230B、330B－発光ゾーン

240－第二電極

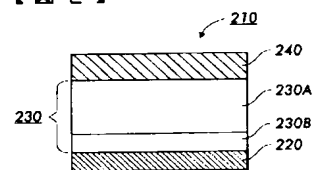
330A－正孔輸送ゾーン

330C－電子輸送ゾーン

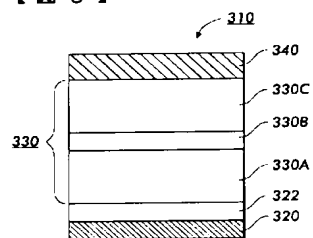
【図1】



【図2】



【図3】



フロントページの続き

(51)Int. Cl.⁷

F I

テーマコード (参考)

C 0 9 K 11/06 6 4 5

C 0 9 K 11/06 6 6 0

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Fターム(参考) 3K007 AB04 AB11 DB03 FA01

PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2004-063465

(43)Date of publication of application : 26.02.2004

(51)Int.Cl.

H05B 33/14
C09K 11/06

(21)Application number : 2003-199678

(71)Applicant : XEROX CORP

(22)Date of filing : 22.07.2003

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(30)Priority

Priority number : 2002 207686
2003 372547

Priority date : 26.07.2002
24.02.2003

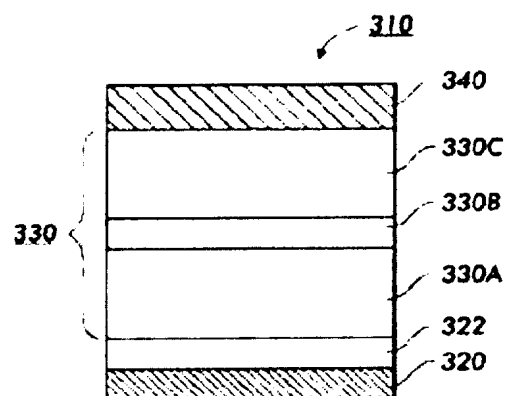
Priority country : US
US

(54) DISPLAY DEVICE INCLUDING ANTHRACENE DERIVATIVE AND TRIAZINE DERIVATIVE

(57)Abstract:

PROBLEM TO BE SOLVED: To improve the performance of a blue color releasing OLED, and in particular, to increase the stability in operation and the color purity.

SOLUTION: In this device including an anode, a cathode and a light emitting zone between the cathode and the anode, the light-emitting zone includes an anthracene derivative compound and a triazine derivative compound.



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3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]

[Claim 1]

An anode,

a cathode -- and

A luminous region between a cathode and an anode

Equipment which is ***** equipment and is characterized by the luminous region containing an anthracene derivative compound and a triazine derivative compound.

[Claim 2]

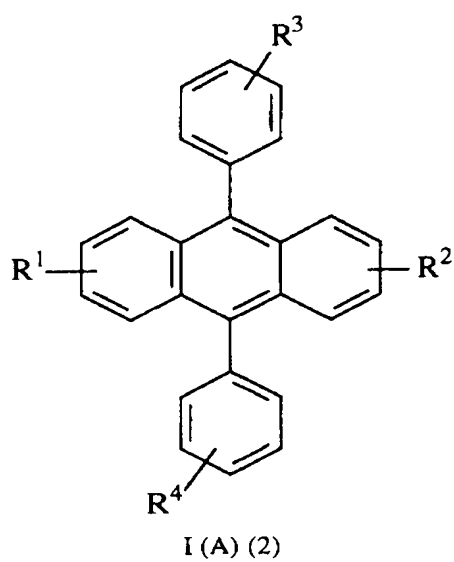
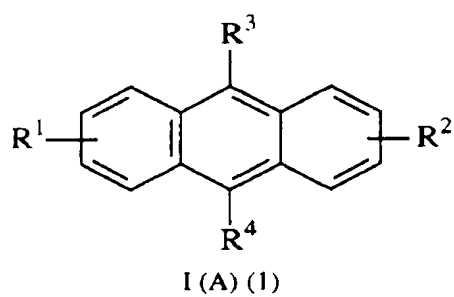
An anode,

a cathode -- and

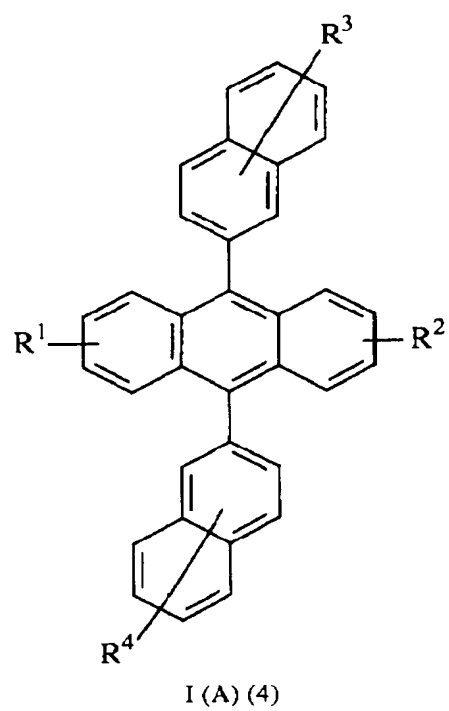
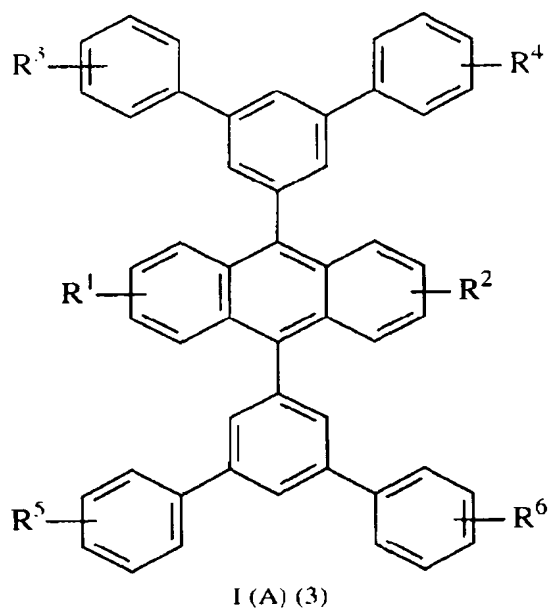
A luminous region between a cathode and an anode

are ***** equipment and the luminous region contains an anthracene derivative compound and a triazine derivative compound -- an anthracene derivative compound -- formula I(A) (1) -I (A), (11), formula I (B), formula I (C), and formula I (D):

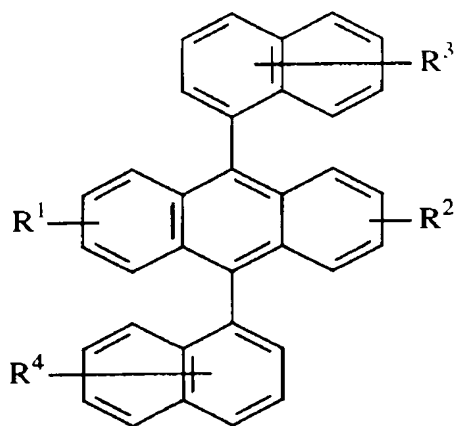
[Chemical formula 1]



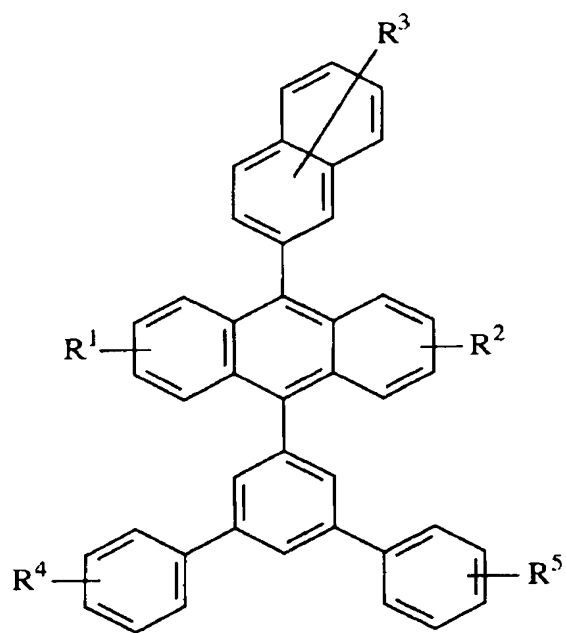
[Chemical formula 2]



[Chemical formula 3]

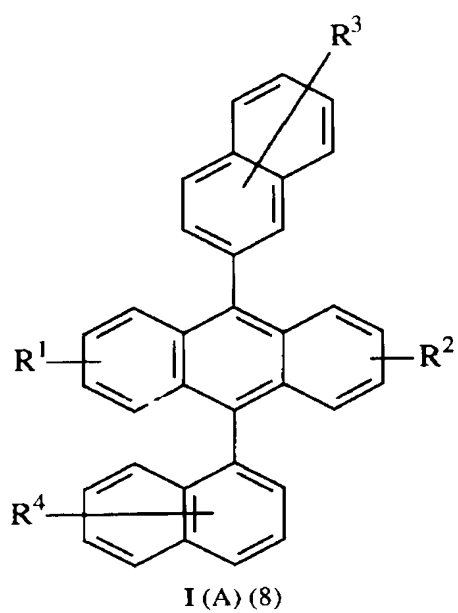
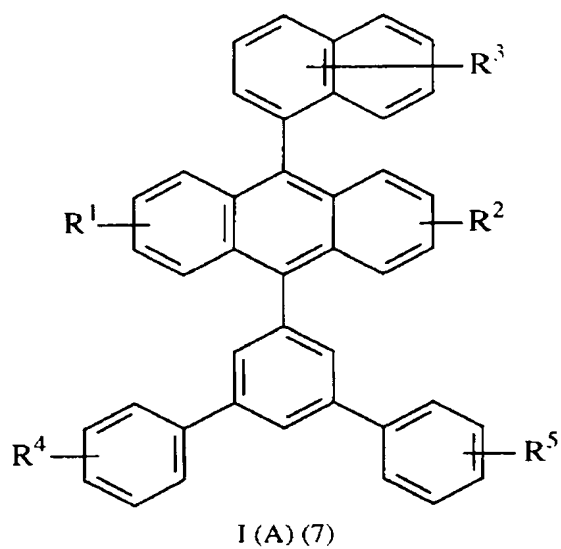


I (A) (5)

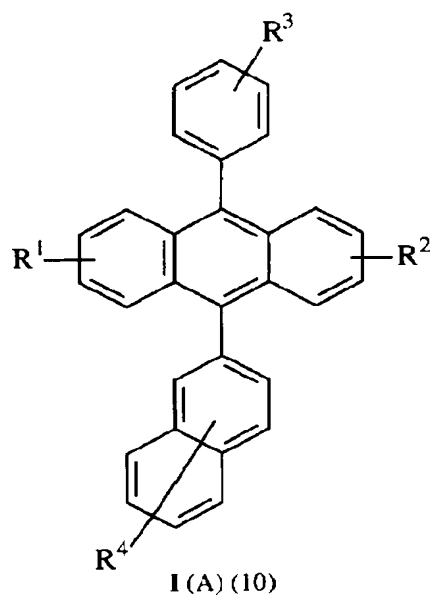
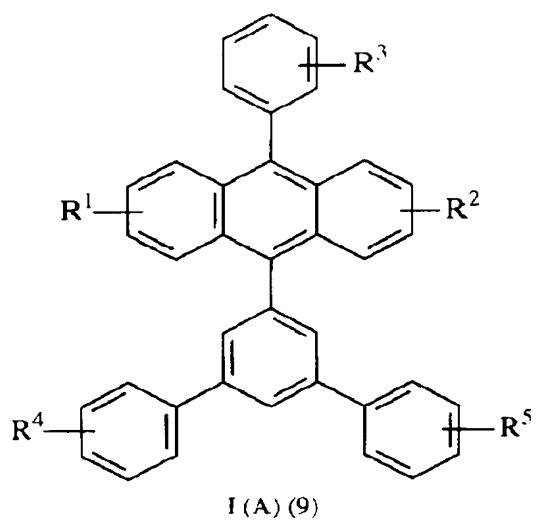


I (A) (6)

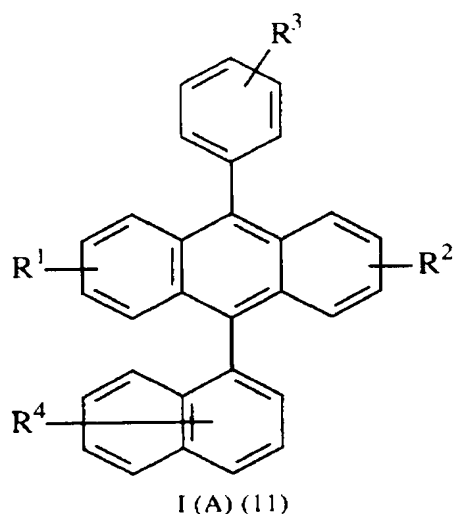
[Chemical formula 4]



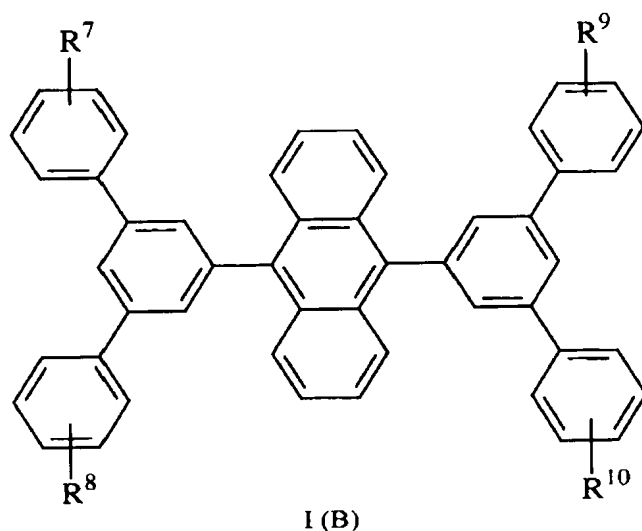
[Chemical formula 5]



[Chemical formula 6]



the inside of a formula, substituent R^1 , R^2 , R^3 , and R^4 independently R^5 and R^6 , respectively Hydrogen, alkyl of 1–24 carbon atoms, It is chosen out of a group which consists of alkoxy ** triphenylsilyl of 1–9 carbon atoms, aryl (this may be replaced as occasion demands) of 6–20 carbon atoms, heteroaryl (this may be replaced as occasion demands) of 5–24 carbon atoms, halogen, and a cyano group.
[Chemical formula 7]



(The inside of a formula, substituent R^7 , R^8 , R^9 , and R^{10} are independent respectively.)

The group 1: Hydrogen or alkyl of 1–24 carbon atoms;

Aryl of a carbon atom of 2:6–20 groups (this may be replaced as occasion demands);

The group 3: A carbon atom required to complete a fused aromatic ring of naphthyl, anthracenyl, pyrenyl, or peri RENIRU;

Heteroaryl of a carbon atom of 4:5–24 groups (this may be replaced as occasion demands);

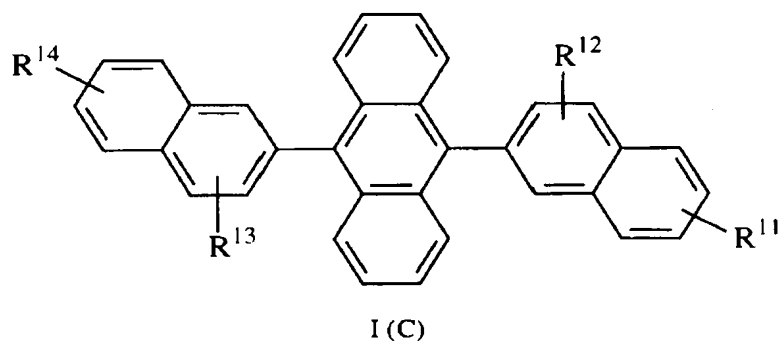
The group 5: A furil, thienyl, pyridyl, or a condensation hetero aromatic ring of kino RINIRU;

An alkoxy group, an amino group, an alkylamino group, or an arylamino group of a carbon atom of 6:1–24 groups; it reaches.

The group 7: Fluoride, chlorine, bromine, or cyano

It is chosen out of a group, ** and others.;

[Chemical formula 8]



(The inside of a formula, substituent R^{11} , R^{12} , R^{13} , and R^{14} are independent respectively.)

The group 1: Hydrogen or alkyl of 1–24 carbon atoms;

Aryl of a carbon atom of 2:6–20 groups (this may be replaced as occasion demands);

The group 3: A carbon atom required to complete a fused aromatic ring of naphthyl, anthracenyl, pyrenyl, or peri RENIRU;

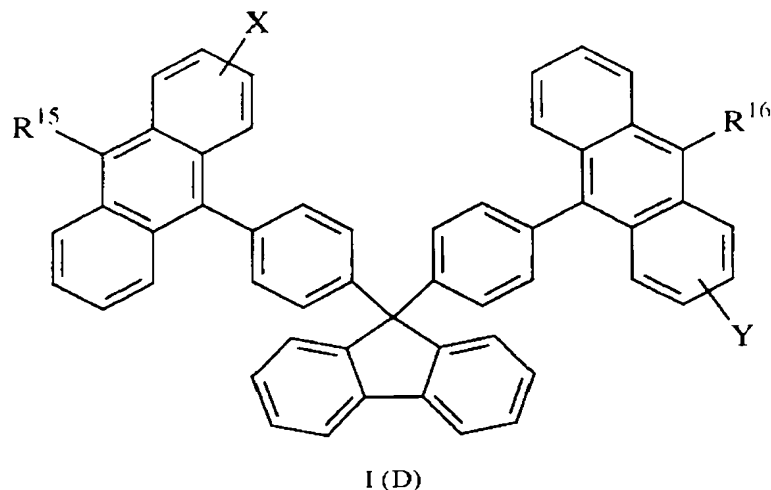
A carbon atom required to complete heteroaryl (this may be replaced as occasion demands) of a carbon atom of 4:5–24 groups, a furil, thienyl, pyridyl, and a condensation hetero aromatic ring of kino RINIRU;

An alkoxy group, an amino group, an alkylamino group, or an arylamino group of a carbon atom of 5:1–24 groups; it reaches.

The group 6: Fluoride, chlorine, bromine, or cyano

It is chosen out of a group, ** and others.;

[Chemical formula 9]



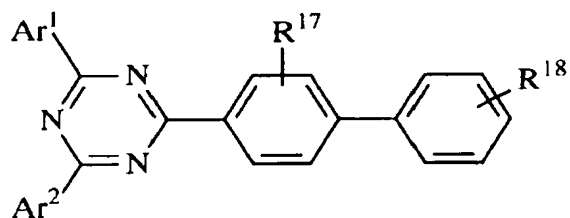
the inside of a formula, R^{15} , and R^{16} -- independent -- hydrogen and 1– alkyl–group and about 6– which has about six carbon atoms -- being chosen out of a group which consists of an aryl group which has about 30 carbon atoms

X and Y are chosen from a group which consists of an alkoxy group which has an alkyl group which has hydrogen, 1 – a carbon atom of six abbreviation independently, an aryl group which has about six pieces – about 30 carbon atoms, 1 – a carbon atom of six abbreviation, halogen, and a cyano group.

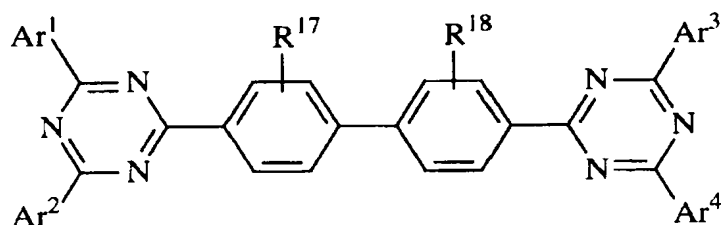
being chosen out of a group, ** and others, -- and

a triazine derivative compound -- formula II (A), II (B), II (C), and II(D):

[Chemical formula 10]

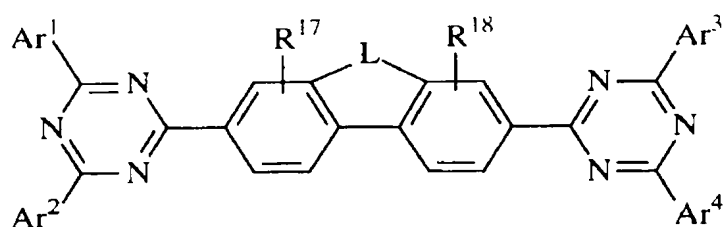


II (A)

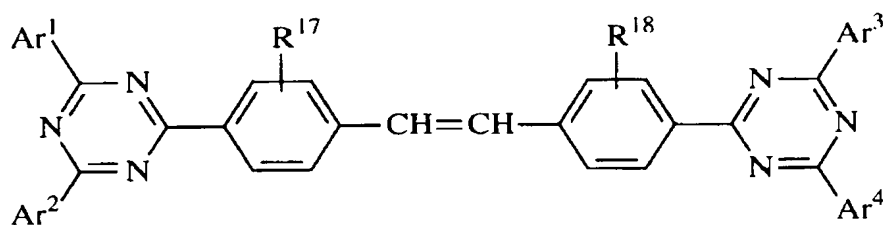


II (B)

[Chemical formula 11]



II (C)



II (D)

(Ar¹, Ar², Ar³, and Ar⁴ being the aryls (this may be replaced as occasion demands) of a carbon atom of 6 – 20 abbreviation independently among a formula, respectively.)

R¹⁷ – R¹⁸ -- independent -- hydrogen and 1– an aliphatic group which has about six carbon atoms, and 1– being chosen out of a group which consists of an alkoxy group which has about six carbon atoms, halogen, and a cyano group -- and

L –C(R'R'')–, ethylene, –Si(R'R'')–, an oxygen atom, Equipment which is the divalent basis chosen from a group which consists of sulfur atoms, and is characterized by choosing R' and R'' from a group which consists of being an alkoxyl group containing an alkyl group which contains a hydrogen atom, 1 – a carbon atom of ten abbreviation independently, respectively and 1 – a carbon atom of ten abbreviation.

[Claim 3]

The equipment according to claim 2 with which an anthracene derivative compound is chosen from a group which consists of formula I (A), (4), and formula I (D).

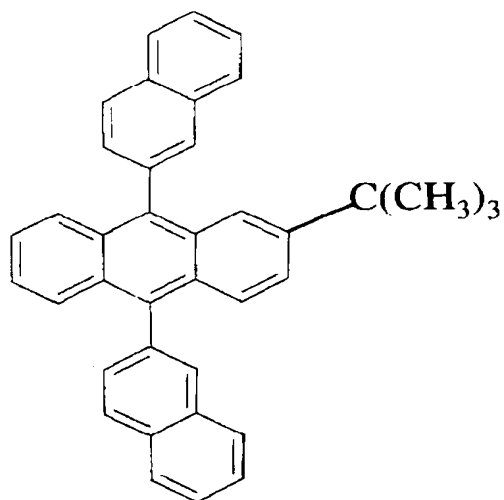
[Claim 4]

The equipment according to claim 2 with which a triazine derivative compound is chosen from the formula II (B).

[Claim 5]

An anthracene derivative compound.

[Chemical formula 12]



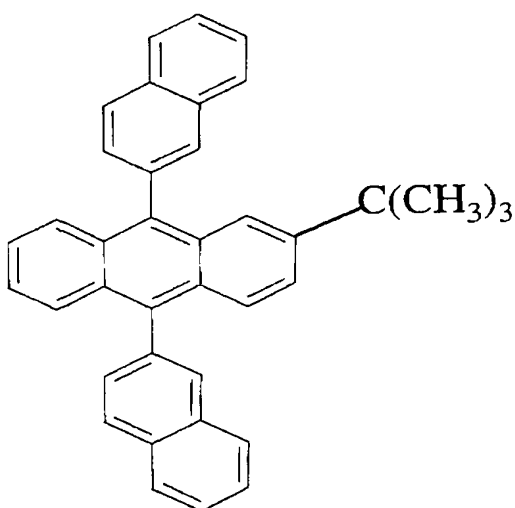
BH2.

It comes out and is a certain equipment according to claim 2.

[Claim 6]

An anthracene derivative compound.

[Chemical formula 13]



BH2.

It comes out and is a certain equipment according to claim 1.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention]

This inventions are parents' U.S. patent application 10th / continuation-in-part application of No. 207,687 (it applied on July 26, 2002), and a preference is claimed after this.

[0002]

[Problem to be solved by the invention]

However, the performance of the blue discharge OLED is improved, those operation stability is increased still more specially, there is a request raise color purity, and this invention tackles it.

[0003]

[Means for solving problem]

Set this invention in the embodiment.

Anode,

a cathode -- and

Formula I (A), (1) – I (A), (11), Equipment with which it is equipment including the luminous region between a cathode and an anode, and the luminous region contains an anthracene derivative compound and a triazine derivative compound; The anthracene derivative compound, It is attained by providing the equipment chosen from the group as which it is chosen out of the group which consists of formula I (B), formula I (C), and formula I (D) and, which a triazine derivative compound becomes [the formula II (A), II (B), II (C) and II (D), (a formula and substituent of these being explained in this Description), and].

[0004]

[Mode for carrying out the invention]

(1) Generally the term "layer" shows the single coating which has a constituent in which the constituents of an adjacent layer differ.

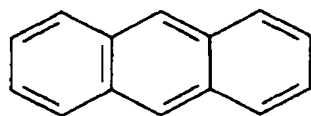
(2) The term "field" expresses a monolayer, two or more layers, for example, two-layer, three layers or more layers than it, and/or one or more "zones."

(3) The term of the "zone" used about a charge transport zone (namely, an electron hole transportation zone and an electron transportation zone) and a luminescence zone expresses the single functional field in a monolayer, two or more layers, and a layer, or two or more functional fields in a layer.

(4) The structural formula of the following [term / of an anthracene derivative compound]

[0005]

[Chemical formula 14]



I

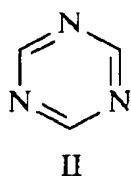
[0006]

The family of the related non-substituted compound and substituted compound containing all of the same structural unit of the three condensation benzene rings that is alike and is expressed more is expressed, and the example of illustration of an anthracene derivative compound is shown in this Description in this case.

Any three of the CH atoms of benzene the term of a triazine derivative compound (5) A continuation style or a discontinuous style, For example, the family of a related non-substituted compound and substituted compound including all the same structural units of the aromatic heterocycle replaced with the nitrogen atom is expressed with 1, the 2 or 3rd place, 1, the 2 or 4th place, 1, the 2 or 5th place, 1, the 2 or 6th place or 1, and the 3 or 5th place. The substitution by a nitrogen atom is a formula.

[0007]

[Chemical formula 15]



[0008]

It may be 1 and the 3 or 5th place, and an example of illustration of a triazine derivative compound is shown in this Description in this case so that it may be alike and may be expressed more.

(6) an operative condition equally regarded as a layer containing an anthracene derivative compound and/or a triazine derivative compound being a portion on a function of an electrode or other nonluminescent fields, or physics — setting like and, Facilities in here are that such a layer containing an anthracene derivative compound and/or a triazine derivative compound is considered to be a part of luminous region.

(7) The term “non-anthracene and non-triazine derivative compound” expresses compounds other than an anthracene derivative compound and a triazine derivative compound.

This organic luminescent device (“OLED”) contains a kind of at least anthracene derivative compound and a kind of triazine derivative compound at least in a luminous region. It may be used for all suitable layer order forewords and a layer presentation attaining this invention.

An embodiment of the first illustration is shown in drawing 1, and among a figure, OLED 110 is the shown order and contains the anode 120, the luminous region 130, and the cathode 140.

The embodiment of the second illustration is shown in drawing 2, and among a figure, OLED 210 is the shown order and contains luminous region 230; and the second electrode 240 including the first electrode 220; luminescence zone 230B and the charge transport zone 230A. The first electrode may be a cathode and, on the other hand, the second electrode is an anode. The first electrode may be an anode and, on the other hand, the second electrode is a cathode. When the second electrode is an anode, a charge transport zone may be an electron hole transportation zone. When the second electrode is a cathode, a charge transport zone may be an electron transportation zone.

[0009]

the embodiment of the third illustration is shown in drawing 3, and OLED 310 is the shown order among a figure — anode 320; — luminous region 330; and the cathode 340 including the arbitrary buffer layer 322; electron hole transportation zones 330A, the luminescence zone 330B, and the electron transportation zone 330C are included.

Since it is expedient, the base material is not shown in drawing 1–3. However, it is understood that a base material contacts two electrodes, for example, and may be arranged by all the suitable places in shown OLED.

A kind of triazine derivative compound at least may exist as more compounds than a kind, two sorts, three sorts, or it. When two or more sorts of triazine derivative compounds exist, it may be independently arranged all over the field where a layer which may be in the state where they may be the mixtures of an equal ratio or the ratio which is not equal, or a triazine derivative compound is not mixed, for example, is different differs from a monolayer. In an embodiment, a kind of triazine derivative compound at least may be considered to be an electron transport substance. It is because transportation of an electron is larger than transportation of an electron hole by a triazine derivative compound if it becomes what. an operative condition -- it sets like and some triazine derivative compounds are electron transportation objects -- in addition -- it may be a substance which a blue emitter, i.e., an electron hole, and an electron combine, and may bring about discharge of the light of the blue area of a visible spectrum.

[0010]

A kind of anthracene derivative compound at least may exist as more compounds than a kind, two sorts, three sorts, or it. When two or more sorts of anthracene derivative compounds exist, it may be independently arranged all over a field where a layer which may be in a state where they may be the mixtures of an equal ratio or a ratio which is not equal, or an anthracene derivative compound is not mixed, for example, is different differs from a monolayer. A kind of anthracene derivative compound at least is a mold of an organic electrophotoluminescence substance which may be considered to be a substance which a blue emitter, i.e., an electron hole, and an electron combine, and may bring about discharge of light of a blue area of a visible spectrum. In an embodiment, a level that some anthracene derivative compounds are insufficient again and remarkable which is good or was excellent conveys both an electron hole, an electron, or an electron hole and an electron. In an embodiment, since anthracene derivative compounds may be both a blue emitter and an electric charge conductor, this double character makes flexibility of a certain grade possible at arrangement of an anthracene derivative compound in OLED.

[0011]

At least a kind of anthracene derivative compound and a kind of triazine derivative compound at least The book OLED. For example, OLED arrangement of the following illustration (when two or more sorts of anthracene derivative compounds exist in OLED) Such an anthracene derivative compound may be mutually the same, moreover -- it may differ --; -- when two or more sorts of triazine derivative compounds exist in OLED again, such a triazine derivative compound may be mutually the same, and may exist all over a bilayer or layers much more larger than it which may be different, a zone, or a field.

- (1) An anode / luminescence zone (anthracene derivative compound) / electron transportation zone (triazine derivative compound) / cathode
- (2) An anode / luminescence zone (anthracene derivative compound + triazine derivative compound) / electron transportation zone (non-anthracene and non-triazine derivative compound) / cathode
- (3) An anode / luminescence zone (anthracene derivative compound + triazine derivative compound) / electron transportation zone (triazine derivative compound) / cathode
- (4) An anode / luminescence zone (anthracene derivative compound + triazine derivative compound) / electron transportation zone (anthracene derivative compound + triazine derivative compound) / cathode
- (5) An anode / luminescence zone (anthracene derivative compound) / electron transportation zone (anthracene derivative compound + triazine derivative compound) / cathode

[0012]

- (6) An anode / luminescence zone (anthracene derivative compound) / electron transportation zone (the first pass of an anthracene derivative compound + triazine derivative compound, and secondary layer of a triazine derivative compound) / cathode
- (7) An anode / luminescence zone (anthracene derivative compound) / electron transportation zone (secondary layer of the first pass of an anthracene derivative compound + triazine derivative compound, non-anthracene, and a non-triazine derivative compound) / cathode
- (8) An anode / electron hole transportation zone (anthracene derivative compound) /

luminescence zone (anthracene derivative compound + triazine derivative compound) / electron transportation zone (triazine derivative compound) / cathode

(9) An anode / electron hole transportation zone (anthracene derivative compound) / luminescence zone (anthracene derivative compound + triazine derivative compound) / electron transportation zone (non-anthracene and non-triazine derivative compound) / cathode

(10) An anode / electron hole transportation zone (anthracene derivative compound) / luminescence zone (anthracene derivative compound + triazine derivative compound) / cathode

(11) An anode / electron hole transportation zone (anthracene derivative compound) / luminescence zone (triazine derivative compound) / cathode

(12) An anode / electron hole transportation zone (anthracene derivative compound) / luminescence zone (triazine derivative compound) / electron transportation zone (triazine derivative compound) / cathode

(13) An anode / electron hole transportation zone (anthracene derivative compound) / luminescence zone (triazine derivative compound) / electron transportation zone (non-anthracene and non-triazine derivative compound) / cathode

(14) An anode / electron hole transportation zone (anthracene derivative compound) / luminescence zone (non-anthracene and non-triazine derivative compound) / electron transportation zone (triazine derivative compound) / cathode.

[0013]

In 6 and 7, the layer of an anthracene derivative compound + triazine derivative compound is equally regarded as it being a part of luminescence zone.

In 1-7, arrangement may also include further the electron hole transportation zone (an anode is adjoined) which may also contain an anthracene derivative compound and/or non-anthracene, and a non-triazine derivative compound as occasion demands.

In 8-14, arrangement may also contain further non-anthracene and a non-triazine derivative compound all over an electron hole transportation zone (an anode is adjoined) as occasion demands.

The luminous region containing an anthracene derivative compound and a triazine derivative compound may be a bilayer, three layers, or more layers than it much more. An anthracene derivative compound and a triazine derivative compound about a monolayer luminous region. For example, two functional field: luminescence zones. (For example, an anthracene derivative compound + triazine derivative compound) and an electron transportation zone. Layer thickness is crossed and it can adhere by various concentration so that (for example, an anthracene derivative compound + triazine derivative compound) may arise. In this case, the concentration of the anthracene derivative compound in an electron transportation zone is smaller than the inside of a luminescence zone, or completely absent from an electron transportation zone by necessity, for example. In an embodiment, the monolayer photogen which contains the mixture of an anthracene derivative compound and a triazine derivative compound with fixed concentration in it is provided. The following [luminous region / multilayer] for example.: The luminous layer between luminous layer; and the electron hole transporting bed in contact with a charge transport layer, and an electron transport layer may also be included.

[0014]

A luminescence zone may also contain the mixture of a single anthracene derivative compound or two or more sorts of anthracene derivative compounds. When the mixture of two or more sorts of anthracene derivative compounds is used, an anthracene derivative compound may exist in all suitable weight ratios, for example, an equal quantity, or the quantity which is not equal. A kind of compound in a mixture may exist in the quantity of the range from 0.1 weight % to 99.9 weight %, for example, and the remainder is a compound more than other kinds. In addition to the anthracene derivative compound more than a kind, charge transport material is based on a luminescence zone. For example, it may exist all over a luminescence zone by the concentration of the range from 0 weight % to about 95 weight %, and the remainder is an anthracene derivative compound more than a kind of the concentration of the range from 100 weight % to about 5 weight % on the basis of a luminescence zone.

A luminescence zone may also contain the mixture of a single triazine derivative compound or

two or more sorts of triazine derivative compounds. When the mixture of two or more sorts of triazine derivative compounds is used, a triazine derivative compound may exist in all suitable weight ratios, for example, an equal quantity, or the quantity which is not equal. A kind of compound in a mixture may exist in the quantity of the range from 0.1 weight % to 99.9 weight %, for example, and the remainder is a compound more than other kinds. In addition to the triazine derivative compound more than a kind, charge transport material is based on a luminescence zone. For example, it may exist all over a luminescence zone by the concentration of the range from 0 weight % to about 95 weight %, and the remainder is a triazine derivative compound more than a kind of the concentration of the range from 100 weight % to about 5 weight % on the basis of a luminescence zone.

[0015]

A luminescence zone may also contain the anthracene derivative compound more than a kind, and the mixture of the triazine derivative more than a kind. When two or more sorts of mixtures, the anthracene derivative compound more than a kind and the triazine derivative compound more than a kind, are used, Each of the anthracene derivative compound more than a kind and the triazine derivative compound more than a kind may exist in all suitable weight ratios, for example, an equal quantity, or the quantity which is not equal. A kind of compound in a mixture may exist in the quantity of the range from 0.1 weight % to 99.9 weight %, for example, and the remainder is a compound more than other kinds. In addition to the anthracene derivative compound more than a kind, and the triazine derivative compound more than a kind, charge transport material is based on a luminescence zone. For example, it may exist all over a luminescence zone by the concentration of the range from 0 weight % to about 95 weight %, and the remainders are an anthracene derivative compound more than a kind of the concentration of the range from 100 weight % to about 5 weight %, and a triazine derivative compound more than a kind on the basis of a luminescence zone.

In an embodiment, a luminescence zone may also contain the non-anthracene and the non-triazine derivative compound more than a kind in all suitable weight ratios, for example, an equal quantity, or the quantity which is not equal. Since the strength of the color of light or the purity of a color emitted compared with the luminescence zone which does not contain the non-anthracene and the non-triazine derivative compound more than such a kind is influenced, the non-anthracene and the non-triazine derivative compound more than these kinds may be added by the luminescence zone. The blue discharge OLED is manufactured in the embodiment of this invention. In another embodiment, when OLED which emits another color adds the non-anthracene and the non-triazine derivative compound more than a kind in a luminescence zone and changes blue with use of the suitable substance in a luminous region to another color, for example, it may be manufactured.

[0016]

A charge transport zone (an electron hole transportation zone or an electron transportation zone is not asked) contains a mixture of two or more sorts of charge transport material of single charge transport material, all suitable weight ratios, for example, an equal quantity, or quantity that is not equal. A kind of compound in a mixture may exist in quantity of a range from 0.1 weight % to 99.9 weight %, for example, and the remainder is a compound more than other kinds. A charge transport zone may also contain an anthracene derivative compound more than a kind, a triazine derivative compound more than a kind, non-anthracene more than a kind and non-triazine compounds, or all these mixtures.

A layer of OLED may be transparent or opaque according to a field of OLED facing those who see. A substance of illustration will be explained to construction of OLED of this invention. A transparent base material may also include substantially various suitable materials containing a polymer component, glass, quartz, etc., for example. Although polyester (registered trademark), for example, a miler, polycarbonate, polyacrylate, polymethacrylate, polysulfone, etc. are mentioned as a suitable polymer component, it is not limited to these. Other support materials may be chosen again.

[0017]

A base material may have the thickness from about 25 micrometers to about 1,000 micrometers

still more specially from about 10 micrometers to about 5,000 micrometers.

An anode may also contain a suitable charge of a positive charge injecting material, for example, indium tin oxide, (ITO), silicon, a tin oxidation thing and metal that has a work function of a range from about 4 eV to about 6 eV, for example, gold, platinum, and palladium. Although not less than about 4 eV of conductive carbon, pi conjugated polymer, for example, poly aniline, a polythiophene, polypyrrole, etc. which have a work function from about 4 eV to about 6 eV especially are mentioned as other materials suitable for an anode, for example, it is not limited to these. A transparent anode substantially a work function of indium tin oxide (ITO) and a range from about 4 eV to about 6 eV, for example, including metal which it has, for example, gold, palladium, etc. from about 10Å to about 200Å, A very thin substantially transparent metal layer which has the thickness from about 30Å to about 100Å especially may also be included. Thickness of an anode may be a range from about 10Å to about 50,000Å, and it depends for a desirable range on an electric constant and an optical constant of an anode material. The range of one illustration of thickness of an anode is from about 300Å to about 3,000Å.

[0018]

A cathode may also include all suitable electron injection materials, for example, metal, containing a high work function ingredient which has a work function from about 4 eV to about 6 eV, for example, metal, and a low work function ingredient which has a work function from about 2 eV to about 4 eV, for example, for example, metal, for example. A cathode may also include combination of low work function (less than about 4 eV) metal and metal of at least a kind of others. An effective ratio of metal of the second or others versus a low work function metal is from less than about 0.1 weight % to about 99.9 weight %. As an example of illustration of a low work function metal, alkaline metal, for example, lithium, or sodium; 2A fellows or alkaline-earth metals, For example, although a group III metal, for example, a scandium, containing beryllium, magnesium, calcium, or barium; rare-earth metal, and an actinide group metal, yttrium, a lanthanum, cerium, europium, a terbium, or actinium is mentioned, it is not limited to these. Lithium, magnesium, and calcium are desirable low work function metals. It is a cathode material desirable although Mg-Ag alloy cathode forms a cathode in an embodiment. Other special cathodes contain a metal-organicity mixed layer (MOML). A cathode can be formed from a lithium alloy with other high work function metal, for example, aluminum, and indium.

[0019]

Metal in which a transparent cathode has a work function of a range from about 2 eV to about 4 eV substantially, For example, Mg, Ag, aluminum, Ca, In, Li(s), and those alloys. For example, Mg containing Ag of Mg of about 80 to 95 volume % and about 20 – about 5 volume % : An Ag alloy, And Li which contains Li of aluminum of volume [about 90 to 99] % and about 10 – volume [about 1] %, for example: A very thin substantially transparent metal layer which has the thickness from about 30Å to about 100Å especially from about 10Å to about 200Å may also be included, including an aluminum alloy etc.

Thickness of a cathode may be a range from about 10 nanometers to about 1,000 nanometers, for example.

An anode and a cathode which are used for the book OLED may be a monolayer, respectively, or may also contain two-layer, three layers, or more layers than it. For example, an electrode may also contain an electric charge pouring layer (namely, an electronic injection layer or a hole injection layer) and a capping layer. However, in an embodiment, it may be thought that an electric charge pouring layer differs from an electrode. Metal in which an electronic injection layer has a work function of a range from about 2 eV to about 4 eV, For example, Mg, Ag, aluminum, Ca, In, Li(s), and those alloys. For example, Mg containing Ag of Mg of about 80 to 95 volume % and about 20 – about 5 volume % : An Ag alloy, And Li which contains Li of aluminum of volume [about 90 to 99] % and about 10 – volume [about 1] %, for example: A very thin substantially transparent metal layer which has the thickness from about 30Å to about 100Å especially from about 10Å to about 200Å may also be included, including an aluminum alloy etc. An electronic injection layer may also include an oxide material or a very thin insulating material like an alkali metal compound which was indicated to US,5,457,565,B, 5,608,287, and 5,739,635 again.

[0020]

A hole injection layer may also contain a suitable charge of a positive charge injecting material, for example, indium tin oxide, (ITO), silicon, a tin oxidation thing and metal that has a work function of a range from about 4 eV to about 6 eV, for example, gold, platinum, and palladium. Although not less than about 4 eV of conductive carbon, pi conjugated polymer, for example, poly aniline, a polythiophene, polypyrrole, etc. which have a work function from about 4 eV to about 6 eV especially are mentioned as other materials suitable for a hole injection layer, for example, it is not limited to these. A transparent hole-injection material may also contain substantially a very thin substantially transparent metal layer which has the thickness from about 30Å to about 100Å especially from about 10Å to about 200Å, including metal which has a work function of a range from about 4 eV to about 6 eV, for example, gold, palladium, etc. An additional suitable form of a hole injection layer is indicated by US,4,885,211,B and 5,703,436.

A capping layer of an anode and/or a cathode may be contained in order to increase thermal stability, and to increase environmental stability and to improve performance of an organic luminescent device by a method of/or others of a certain kind. An example of a capping layer which can use the thermal stability of an organic luminescent device for increasing is a layer containing SiO, SiO₂, or these mixtures. An example of a capping layer which can use the environmental stability of an organic luminescent device for increasing is a layer containing stable metal, for example, Ag, aluminum, In, or Au. Another example of a capping layer which can use the environmental stability of an organic luminescent device for increasing is a layer which contains a low work function metal which was indicated to US,5,059,861,B, for example. Thickness of a capping layer may be a range from [from about 20 nanometers to about 5,000 nanometers] about 50 nanometers to 500 nanometers, for example.

[0021]

A buffer layer may also include material which has the hole-injection characteristic of a certain kind and transport properties, and it is chosen so that device performance may be improved. As a suitable material which can be used into a buffer layer, a semiconductor organic material. For example, a porphyrin derivative like 1,10,15,20-tetraphenyl-21 H,23H-porphyrin copper (II) indicated by US,4,356,429,B; A copper phthalocyanine, copper tetramethyl phthalocyanine; -- zinc phthalocyanine; -- titanium oxide phthalocyanine; -- magnesium phthalocyanine etc. are mentioned and a copper phthalocyanine is one desirable example. A mixture of such materials and other suitable materials can use it again. As a suitable material of others which can be used into a buffer layer, a semiconductor and insulating metallic compounds, For example, MgO, aluminum₂O₃, BeO, BaO, AgO, SrO, SiO, SiO₂, ZrO₂, CaO, Cs₂O, Halogenated metal like metallic-oxide; like Rb₂O, Li₂O, K₂O, and Na₂O and LiF, KCl, NaCl, CsCl, CsF, and KF is mentioned. A buffer layer may have the thickness of a range from [from about 5 nm to about 25 nm] about 1 nm to about 5 nm from about 1 nm to about 100 nm.

As an anthracene derivative compound of illustration, an anthracene derivative compound of a compound of EP 1009044 A2, general structural-formula I (A), (1) - I (A) and (11) is mentioned.

[0022]

The inside of a formula, substituent R¹, R², R³, R⁴, Independently R⁵ and R⁶, respectively Hydrogen, alkyl of 1-24 carbon atoms, Alkoxy ** triphenylsilyl of 1-9 carbon atoms, aryl of 6-20 carbon atoms (this may be replaced as occasion demands), It is chosen out of a group which consists of heteroaryl (this may be replaced as occasion demands) of 5-24 carbon atoms, halogen, for example, fluoride, chlorine, bromine, and a cyano group. A hetero atom in heteroaryl may be nitrogen, sulfur, or oxygen, for example. A portion from which aryl and heteroaryl are the same as, or differ as occasion demands. For example, the following portion: It may be replaced by alkyl of 1-9 carbon atoms and alkoxy ** halogen of 1-9 carbon atoms, for example, fluoride, chlorine, bromine, cyano group, etc. by more number of times than 1 time, 2 times, or it.

[0023]

What was indicated by US,5,972,247,B is mentioned as an anthracene derivative compound of other illustration, and an anthracene derivative compound of general structural-formula I (B) is

indicated there.

the inside of a formula, substituent R^7 , R^8 , R^9 , and R^{10} -- respectively -- independent

The group 1: Hydrogen or alkyl of 1-24 carbon atoms;

Aryl of a carbon atom of 2:6-20 groups (this may be replaced as occasion demands);

The group 3: A carbon atom required to complete a fused aromatic ring of naphthyl, anthracenyl, pyrenyl, or peri RENIRU;

Heteroaryl of a carbon atom of 4:5-24 groups (this may be replaced as occasion demands);

The group 5: A furil, thienyl, pyridyl, or a condensation hetero aromatic ring of kino RINIRU;

An alkoxy group, an amino group, an alkylamino group, or an arylamino group of a carbon atom of 6:1-24 groups; it reaches.

The group 7: Fluoride, chlorine, bromine, or cyano

It is chosen out of a group, ** and others.

A hetero atom in heteroaryl may be nitrogen, sulfur, or oxygen, for example. A portion from which aryl and heteroaryl are the same as, or differ as occasion demands. For example, the following portion: It may be replaced by alkyl of 1-9 carbon atoms and alkoxy ** halogen of 1-9 carbon atoms, for example, fluoride, chlorine, bromine, cyano group, etc. by more number of times than 1 time, 2 times, or it.

[0024]

As an anthracene derivative compound of other illustration, what was indicated by US,5,935,721,B, and an anthracene derivative compound of general structural-formula I (C) are mentioned.

the inside of a formula, substituent R^{11} , R^{12} , R^{13} , and R^{14} -- respectively -- independent

The group 1: Hydrogen or alkyl of 1-24 carbon atoms;

Aryl of a carbon atom of 2:6-20 groups (this may be replaced as occasion demands);

The group 3: A carbon atom required to complete a fused aromatic ring of naphthyl, anthracenyl, pyrenyl, or peri RENIRU;

Heteroaryl (this may be replaced as occasion demands) of a carbon atom of 4:5-24 groups, a furil, thienyl, pyridyl, a condensation hetero aromatic ring of kino RINIRU, and a carbon atom required to complete other heterocyclic systems;

An alkoxy group, an amino group, an alkylamino group, or an arylamino group of a carbon atom of 5:1-24 groups; it reaches.

The group 6: Fluoride, chlorine, bromine, or cyano

It is chosen out of a group, ** and others.

A hetero atom in heteroaryl may be nitrogen, sulfur, or oxygen, for example. A portion from which aryl and heteroaryl are the same as, or differ as occasion demands. For example, the following portion: It may be replaced by alkyl of 1-9 carbon atoms and alkoxy ** halogen of 1-9 carbon atoms, for example, fluoride, chlorine, bromine, cyano group, etc. by more number of times than 1 time, 2 times, or it.

One desirable example of these anthracene derivative compounds of general formula I (C) is a 9,10-di-(2-naphthyl) anthracene derivative compound.

[0025]

As another example of an anthracene derivative compound, a compound shown by the formula I (D) is mentioned.

the inside of a formula, R^{15} , and R^{16} -- independent -- hydrogen and 1- alkyl-group and about 6- which has about six carbon atoms -- it is chosen out of a group which consists of an aryl group which has about 30 carbon atoms. Special examples of a substituent about R^{15} and R^{16} are hydrogen, methyl, tert-butyl, a phenyl, naphthyl, etc. X and Y are chosen from a group which consists of an alkoxy group which has an alkyl group which has hydrogen, for example, 1, - a carbon atom of six abbreviation independently and an aryl group which has about six pieces - about 30 carbon atoms -, for example, 1, and a carbon atom of six abbreviation, halogen, a cyano group, etc. Special examples of a substituent about X and Y are hydrogen, methyl, tert-butyl, tert-butoxy, etc.

[0026]

As an example of a triazine derivative compound, a compound indicated by US,6,229,012,B, 6,225,467, and 6,057,048 is mentioned. A triazine derivative compound of illustration is contained by the formula II (A) – II (D), for example.

Ar^1 , Ar^2 , Ar^3 , and Ar^4 are the aryls (this may be replaced as occasion demands) of a carbon atom of 6 – 20 abbreviation independently among a formula, respectively. The aryl may be chosen from a group which consists of a phenyl, stilbenyl, biphenyl, naphthyl, pyridyl, quinolyl, etc., for example. An alkyl group in which an aryl group has 1 – a carbon atom of six abbreviation as occasion demands, for example, For example, it may be replaced by substituent chosen from a group which consists of a dialkylamino group which has an alkoxy group which has 1 – a carbon atom of six abbreviation –, for example, 1, and a carbon atom of three abbreviation, halogen, a cyano group, etc. by more number of times than 1 time, 2 times, or it.

R^{17} – R^{18} – independent – hydrogen and an aliphatic group, for example, 1–, – an alkyl group which has about six carbon atoms, for example, 1–, – being chosen out of a group which consists of an alkoxy group which has about six carbon atoms, halogen, for example, chlorine, and a cyano group

L is a divalent basis which may be chosen from a group which consists of $-C(R'R'')$ –, ethylene, $-Si(R'R'')$ –, an oxygen atom, a sulfur atom, etc. – R' and R'' – respectively – independent – a hydrogen atom and 1– an alkyl group containing about ten carbon atoms or 1– it is an alkoxyl group containing about ten carbon atoms.

[0027]

A luminous region, especially a luminescence zone may also contain further (photogene on the basis of weight of a luminescence zone) from about 0.01 weight % to about 25 weight % as a dopant. Examples of a dopant substance which can be used all over a luminous region are a fluorescent substance, for example, a coumarin, a dicyanomethylene pyran, poly methine, oxa BENZUAN tolan, a xanthene, pyrylium, a carbo still, perylene, etc. Another desirable class of a fluorescent substance is the Quinacridone color. As an example of illustration of the Quinacridone color, US,5,227,252,B, Quinacridone which was indicated by 5,276,381 and 5,593,788, 2-methyl Quinacridone, 2,9-dimethyl Quinacridone, 2-chloro Quinacridone, 2-fluoro Quinacridone, 1,2-benzo Quinacridone, N,N'-dimethyl Quinacridone, N,N'-dimethyl- 2-methyl Quinacridone, N,N'-dimethyl- 2,9-dimethyl Quinacridone, N,N'-dimethyl- 2-chloro Quinacridone, N,N'-dimethyl- 2-fluoro Quinacridone, N,N'-dimethyl- 1,2-benzo Quinacridone, etc. are mentioned. Another class of a fluorescent substance which can be used is condensed ring fluorescent dye. As suitable condensed ring fluorescent dye of illustration, perylene, rubrene, anthracene, coronene, a phenan training center, pyrene, etc. which were indicated by US,3,172,862,B are mentioned. Butadiene which was indicated by US,4,356,429,B and 5,516,577, for example, 1,4-diphenylbutadiene, tetraphenylbutadiene, a stilbene, etc. are mentioned as a fluorescent substance. An example of others of a fluorescent substance which can be used is indicated by US,5,601,903,B.

[0028]

Fluorescent dye by which a luminescence dopant which can be used all over a luminous region was indicated by US,5,935,720,B, For example, 4-(dicyanomethylene)-2-I-propyl-6-(1,1,7,7-tetramethyl JURO lysyl-9-ene yl)-4H-Piran (DCJTB); A lanthanide metal chelate complex, For example, a tris(acetylacetonate) (phenanthroline) terbium, Tris(acetylacetonate) (phenanthroline) europium, And tris(TENOIRU trisfluoro acetate) (phenanthroline) europium, And what [was indicated by Kido and others, "white light emission organicity electrophotoluminescence equipment which uses a lanthanide complex", Jpn. J. Appl. Phys., 35 volumes, and L394-L396 page (1996)]; and a phosphorescence substance, For example, an organic metallic compound containing a heavy metal atom which brings about strong spin orbit coupling, For example, it is indicated by Baldo and others, "organic phosphorus light emission effective in an altitude from organic electrophotoluminescence equipment", Letters to Nature, 395 volumes, and 151-154 (1998). As a desirable example, 2,3,7,8,12,13,17,18-octaethyl-21H23H-FORUPIN platinum (II) (PtOEP) and fac tris(2-phenylpyridine) iridium ($Ir(ppy)_3$) are mentioned.

[0029]

In addition to a triazine derivative substance and an anthracene derivative substance, a luminous region, especially an electron hole transportation zone may also contain a substance of others more than a kind which has electron hole transport properties again. Polypyrrole which was indicated by US,5,728,801,B as an example of an electron hole transportation substance which can be used all over a luminous region, Poly aniline, poly (phenylenevinylene), a polythiophene, polyarylamine, And those derivatives and a known semiconductor organic substance; A porphyrin derivative, For example, 1,10,15,20-tetraphenyl-21 H,23H-porphyrin copper (II) indicated by US,4,356,429,B; A copper phthalocyanine, copper tetramethyl phthalocyanine; -- zinc phthalocyanine; -- titanium oxide phthalocyanine; -- magnesium phthalocyanine etc. are mentioned.

[0030]

A special class of an electron hole transportation substance which can be used all over a luminous region is indicated by the third class of aromatic amine, for example, US,4,539,507,B. As the third class of aromatic amine of suitable illustration, a bis(4-dimethylamino 2-methylphenyl) phenylmethane, N,N,N'-bird (p-tolyl) amine, 1,1-bis(4-di-p-tolylamino phenyl)cyclohexane, 1,1-bis(4-di-p-tolylamino phenyl)-4-phenylcyclohexane, N,N'-diphenyl-N,N'-bis(3-methylphenyl)-1,1'-biphenyl 4,4'-diamine, N,N'-diphenyl-N,N'-bis(3-methylphenyl)-1,1'-biphenyl 4,4'-diamine, N,N'-diphenyl-N,N'-bis(4-methoxyphenyl)-1,1'-biphenyl 4,4'-diamine, N,N,N',N'-tetra-p-tolyl 1,1'-biphenyl 4,4'-diamine, Although N,N'-di-1-naphthyl N,N'-diphenyl-1,1'-biphenyl 4,4'-diamine, N,N'-bis(p-biphenyl)-N,N'-diphenylbenzidines (biphenyl TPD), these mixtures, etc. are mentioned, it is not limited to these. A desirable class of the third class aromatic amine which can be used all over a luminous region is a naphthyl substitution benzidine derivative (NPD), for example, N,N'-JI (naphthalene-1-yl)-N,N'-diphenyl-benzidine. Another class of the third class of aromatic amine is polynuclear aromatic amine. As an example of such polynuclear aromatic amines, it is N,N-bis- [4'-(N-phenyl-N-m-tolylamino)-4-biphenyl] Aniline, N,N-bis- [4'-(N-phenyl-N-m-tolylamino)-4-biphenyl] -m-toluidine, N,N-bis- [4'-(N-phenyl-N-m-tolylamino)-4-biphenyl] -p-toluidine,

[0031]

N,N-bis- [4'-(N-phenyl-N-p-tolylamino)-4-biphenyl] Aniline, N,N-bis- [4'-(N-phenyl-N-p-tolylamino)-4-biphenyl] -m-toluidine, N,N-bis- [4'-(N-phenyl-N-p-tolylamino)-4-biphenyl] -p-toluidine, N,N-bis- [4'-(N-phenyl-N-p-chlorophenylamino)-4-biphenyl] -m-toluidine, N,N-bis- [4'-(N-phenyl-N-m-chlorophenylamino)-4-biphenyl] -m-toluidine, N,N-bis- [4'-(N-phenyl-N-m-chlorophenylamino)-4-biphenyl] -p-toluidine, N,N-bis- [4'-(N-phenyl-N-m-tolylamino)-4-biphenyl] -p-chloroaniline, N,N-bis- [4'-(N-phenyl-N-p-tolylamino)-4-biphenyl] -m-chloroaniline, N,N-bis- [4'-(N-phenyl-N-m-tolylamino)-4-biphenyl] A 4,4'-bis[, such as-1-aminonaphthalenes and these mixtures,](9-carbazolyl)-1 and 1'-biphenyl compound, For example, although 4,4'-bis(9-carbazolyl)-1,1'-biphenyl, 4,4'-bis(3-methyl-9-carbazolyl)-1,1'-biphenyl, etc. are mentioned, it is not limited to these.

[0032]

The thing 5 by which a special class of an electron hole transportation substance which can be used all over a luminous region was indicated by US,5,942,340,B and 5,952,115, for example, 5,11-di-naphthyl, 11-dihydroindolo [3, 2-b] Carbazole and the 2,8-dimethyl- 5,11-di-naphthyl 5, 11-dihydroindolo [3, 2-b] Carbazole; it is N,N,N',N'-tetra aryl benzidine (aryl may be chosen from a phenyl, m-tolyl, p-tolyl, m-methoxyphenyl, p-methoxyphenyl, 1-naphthyl, 2-naphthyl, etc.). An example of illustration of N,N,N',N'-tetra aryl benzidine N,N'-di-1-naphthyl N,N'-diphenyl-1,1'-biphenyl 4,4'-diamine (this is still more preferred), It is N,N'-bis(3-methylphenyl)-N,N'-diphenyl-1,1'-biphenyl 4,4'-diamine and N,N'-bis(3-methoxyphenyl)-N,N'-diphenyl-1,1'-biphenyl 4,4'-diamine etc.

[0033]

In an embodiment, a luminous region may also contain non-anthracene and a non-triazine derivative compound more than a kind which has desired character, for example, the electron transportation characteristic, and/or a luminescent characteristic. In an embodiment, some non-anthracenes and non-triazine derivative compounds of the following illustration may have the electron transportation characteristic and/or a luminescent characteristic, In this way, :Polyful

Oren who may be useful all over a luminous region (for example, a luminescence zone and/or an electron transportation zone), For example, poly (9,9-di-n-octylfluorene-2,7-diyl), poly (a copolymer containing 2,8- (6,7,12,12-tetra alkyl indeno fluorene) and a fluorene.) Bernius and others [for example,], The proceedings III of a SPIE meeting on organic photogene and equipment, Denver, Colorado, July, 1999, 3797 volumes, and fluorene-Aminco polymer that was indicated by 129 pages.

As other suitable non-anthracenes and non-triazine derivative compounds, metal oxy NOIDO which was indicated by US,4,539,507,B, 5,151,629, 5,150,006, 5,141,671, and 5,846,666 is mentioned. As a special example of illustration, tris(8-hydroxy kino RINETO) aluminum (Alq₃) and bis(8-hydroxy kino rate)-(4-phenylphenolate) aluminum (Balq) are mentioned. As other examples, tris(8-hydroxy kino RINETO) gallium, Bis(8-hydroxy kino RINETO)magnesium, bis(8-hydroxy kino RINETO)zinc, tris(5-methyl-8-hydroxy kino RINETO) aluminum, tris(7-propyl-8-KINORINO rate) aluminum, a screw [Benzo {f}-8-kino RINETO] Zinc, a screw (10-HIDOROKISHIBENZO) [h]Kino RINETO beryllium etc. are mentioned.

[0034]

Another suitable class of non-anthracene and a non-triazine derivative compound is indicated by stilbene derivative, for example, US,5,516,577,B. . Further example of non-anthracene and a non-triazine derivative compound was shown in US,5,846,666,B (the indication is thoroughly included in this Description as reference). A metal thio KISHINOIDO compound, for example, bis(8-quinolinethiolate)zinc, Bis(8-quinolinethiolate)cadmium, tris(8-quinolinethiolate) gallium, Tris(8-quinolinethiolate) indium, bis(5-methylquinolinethiolate)zinc, Tris(5-methylquinolinethiolate) gallium, tris(5-methylquinolinethiolate) indium, bis(5-methylquinolinethiolate)cadmium, bis(3-methylquinolinethiolate)cadmium, bis(5-methylquinolinethiolate)zinc, a screw [Benzo {f}-8-quinolinethiolate] Zinc, a screw [3-methylbenzo {f}-8-quinolinethiolate] Zinc, a screw [3,7-dimethylbenzo {f}-8-quinolinethiolate] They are metal thio KISHINOIDO compounds, such as zinc. Special non-anthracene and a non-triazine derivative compound are bis(8-quinolinethiolate)zinc, bis(8-quinolinethiolate)cadmium, tris(8-quinolinethiolate) gallium, tris(8-quinolinethiolate) indium, and a screw. [Benzo {f}-8-quinolinethiolate] It is zinc.

[0035]

Other suitable non-anthracenes and non-triazine derivative compounds are the oxadiazole metal chelates indicated by contained US,5,925,472,B, and are a screw as these substances. [A 2-(2-hydroxyphenyl)-5-phenyl-1,3,4-oxadiazole rate] Zinc, a screw [A 2-(2-hydroxyphenyl)-5-phenyl-1,3,4-oxadiazole rate] Beryllium, a screw [A 2-(2-hydroxyphenyl)-5-(1-naphthyl)-1,3,4-oxadiazole rate] Zinc, a screw [A 2-(2-hydroxyphenyl)-5-(1-naphthyl)-1,3,4-oxadiazole rate] Beryllium, a screw [A 5-biphenyl 2-(2-hydroxyphenyl)-1,3,4-oxadiazole rate] Zinc, a screw [A 5-biphenyl 2-(2-hydroxyphenyl)-1,3,4-oxadiazole rate] Beryllium, a bis(2-hydroxyphenyl)-5-phenyl-1,3,4-oxadiazole rate] Lithium, a screw [A 2-(2-hydroxyphenyl)-5-p-tolyl 1,3,4-oxadiazole rate] Zinc, a screw [A 2-(2-hydroxyphenyl)-5-p-tolyl 1,3,4-oxadiazole rate] Beryllium, a screw [A 5-(p-tert-buthylphenyl)-2-(2-hydroxyphenyl)-1,3,4-oxadiazole rate] Zinc, a screw [A 5-(p-tert-buthylphenyl)-2-(2-hydroxyphenyl)-1,3,4-oxadiazole rate] Beryllium, a screw [A 2-(2-hydroxyphenyl)-5-(3-fluorophenyl)-1,3,4-oxadiazole rate] Zinc, a screw [A 2-(2-hydroxyphenyl)-5-(4-fluorophenyl)-1,3,4-oxadiazole rate] Zinc, a screw [A 2-(2-hydroxyphenyl)-5-(4-fluorophenyl)-1,3,4-oxadiazole rate] Beryllium, a screw [A 5-(4-chlorophenyl)-2-(2-hydroxyphenyl)-1,3,4-oxadiazole rate] Zinc, a screw [A 2-(2-hydroxyphenyl)-5-(4-methoxyphenyl)-1,3,4-oxadiazole rate] Zinc, a screw [A 2-(2-hydroxy-4-methylphenyl)-5-phenyl-1,3,4-oxadiazole rate] Zinc,

[0036]

Screw[2-alpha-(2-hydroxynaphthyl)-5-phenyl-1,3,4-oxadiazole rate] Zinc, a screw [2-(2-hydroxyphenyl)-5-p-pyridyl 1,3,4-oxadiazole rate] Zinc, a screw [2-(2-hydroxyphenyl)-5-p-pyridyl 1,3,4-oxadiazole rate] Beryllium, a screw [2-(2-hydroxyphenyl)-5-(2-thiophenyl)-1,3,4-oxadiazole rate] Zinc, a screw [2-(2-hydroxyphenyl)-5-phenyl-1,3,4-thiadiazole rate] Zinc, a screw [2-(2-hydroxyphenyl)-5-phenyl-1,3,4-thiadiazole rate] Beryllium, a screw [2-(2-hydroxyphenyl)-5-(1-naphthyl)-1,3,4-thiadiazole rate] Zinc and a screw [2-(2-hydroxyphenyl)-5-(1-naphthyl)-1,3,4-thiadiazole rate] Beryllium etc. are mentioned. Another suitable classes of non-anthracene and a

non-triazine derivative compound are quinoline, for example, 1,4-bis(4-phenylquinolin-2-yl) benzene, and 4,4'-bis(4-phenylquinolin-2-yl)-1,1'-biphenyl (TA).

[0037]

In an embodiment in which a luminous region adds to an organic electrophotoluminescence substance more than a kind, and contains an electron hole transportation substance more than a kind, and/or an electron transport substance more than a kind, A layer with separate organic electrophotoluminescence substance, electron hole transportation substance more than a kind, and/or electron transport substance more than a kind, For example, are generable in OLED indicated by US,4,539,507,B, 4,720,432, and 4,769,292, In the same layer, it is generated and Or a mixing zone of two or more sorts of substances, for example, US,5,853,905,B, OLED indicated by 5,925,980, 6,130,001, 6,114,055, 6,392,250, and 6,392,339 can be formed.

Thickness of a luminous region may change from about 500Å to about 1,500Å from about 200Å to about 2,000Å especially typically from about 10Å to about 10,000Å, for example. In an embodiment in which a luminous region contains two or more layers, each layer thickness may be from about 100Å to about 1,500Å from about 50Å to about 2,000Å especially typically from about 10Å to about 5,000Å, for example.

[0038]

Each layer of OLED may cross layer thickness, generally it may have a uniform or un-uniform presentation, and each layer contains thoroughly a mixture of a kind of substance or a substance in this case.

OLED can be processed by forming a desired layer continuously on a base material using all suitable thin film coating technology and adhesion according to spin covering or heat evaporation in a vacuum typically. Further details about processing and operation of an organic luminescent device are indicated by US,4,539,507,B and 4,769,292, for example.

performance improved compared with OLED in which an organic luminescent device of this invention contains the other blue discharge OLED, for example, an anthracene derivative compound as released goods, and a quinoline type metal chelate derivative compound (this is not a triazine derivative compound) as an electron transport substance -- for example, Still higher operation stability and improved color purity can be shown.

Especially all the % and number of copies are weight references unless it is shown.

[0039]

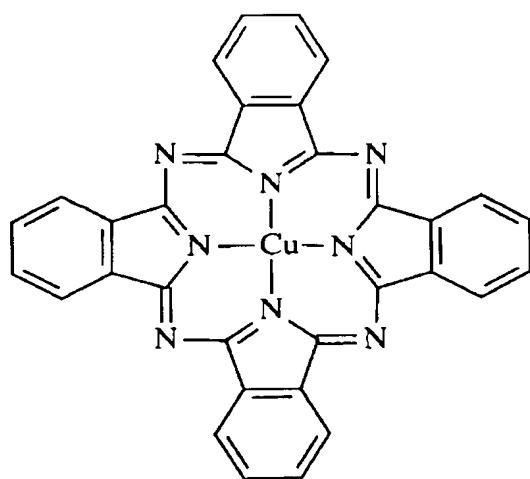
[Working example]

Embodiment 1

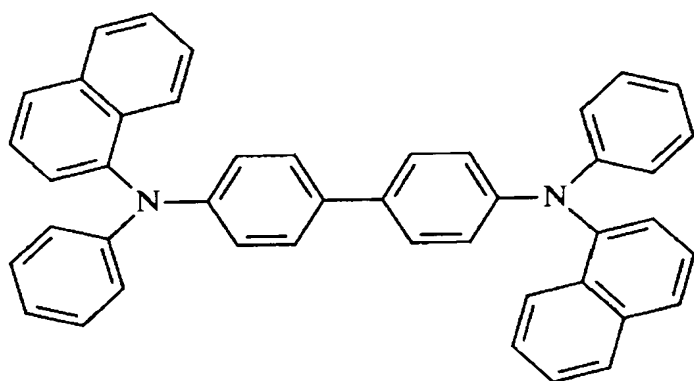
A structure ITO anode. (50 nm) / CuPc porphyrin compound buffer layer. (15 nm) / NPB3 -- a class aromatic amine compound electron hole transporting bed (30 nm) / BH2 anthracene-derivative compound emitter layer (30 nm) / T1 triazine-derivative compound electron transport layer (20 nm) / Mg:Ag cathode (a volume ratio of 9:1 of Mg:Ag.) A 200-nm organic luminescent device (called the equipment A among this Description) was processed. The molecular structure of CuPc, NPB, BH2, and T1 is as follows.

[0040]

[Chemical formula 16]



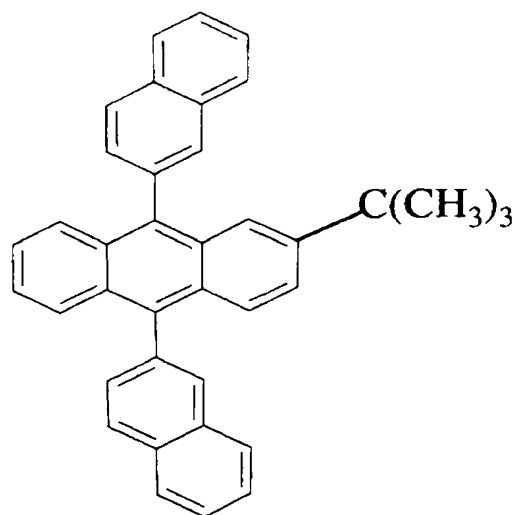
CuPc



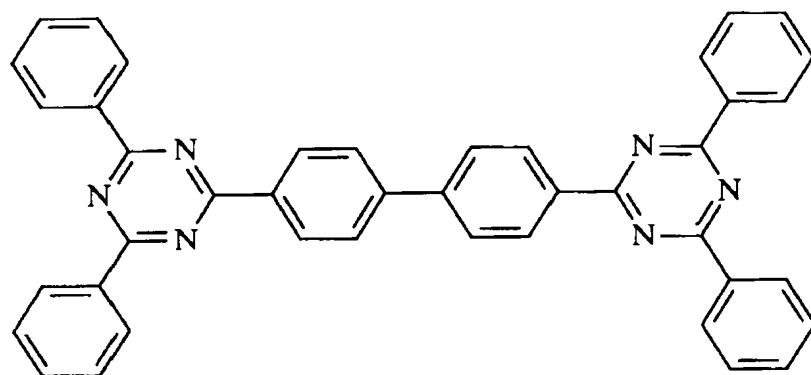
NPB

[0041]

[Chemical formula 17]



BH2



T1

[0042]

That equipment was processed by vacuum adhesion by a base pressure of a 5×10^{-6} torr, and heat evaporation of all the organic layers and cathodes was carried out in this case on an ITO covering glass support body front-washed using UV-ozone cleaning.

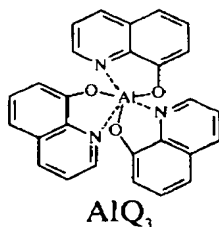
Current density = when it operated using 31.25 mA/cm^2 , the equipment produced color purity which is equivalent to coordinates (0.144, 0.083) with blue discharge and a CIE chart of strength of 240 cd/m^2 . Operation voltage needed for operating equipment on these conditions was 8.7 volts. After continuous operation of 60 hours, attenuation of discharge strength was less than 1% of early strength in this current density under a nitrogen atmosphere.

The comparative example 1 (conventional technology)

A structure ITO anode. (50 nm) / CuPc porphyrin compound buffer layer. (15 nm) / NPB3 -- class aromatic amine compound electron hole transporting bed (30 nm) / BH2 anthracene-derivative compound emitter layer (30 nm) / AlQ₃ quinoline type metal chelate derivative compound electron transport layer (20 nm) / Mg:Ag cathode (Mg:Ag 9:1 volume ratios) A 200-nm organic luminescent device (called the equipment B among this Description). Molecular structure of AlQ₃

[0043]

[Chemical formula 18]



[0044]

It comes out.

The molecular structure of the organic compound of all the others was shown in the previous embodiment.

That equipment was processed by vacuum adhesion by the base pressure of the 5×10^{-6} torr, and heat evaporation of all the organic layers and cathodes was carried out in this case on the ITO covering glass support body front-washed using UV-ozone cleaning.

Current density = when it operated using 31.25 mA/cm^2 , the equipment produced the color purity which is equivalent to coordinates (0.154, 0.114) with blue discharge and the CIE chart of the strength of 390 cd/m^2 . The operation voltage needed for operating equipment on these conditions was 8.3 volts. After the continuous operation of 60 hours, attenuation of discharge strength was about 10% of early strength in this current density under a nitrogen atmosphere. If the performance of the equipment A (this invention) and B (conventional technology) is compared, it is clear equipment's A to have indicated that still higher color purity was clear from CIE coordinates and the especially still smaller value about "y" (namely, the second) coordinates. The high color purity of the equipment A actually satisfied NTSC engineering specification (the NTSC standard about blue coordinates is (0.14 and 0.08)). Clearly, the equipment B does not satisfy these standards. In addition to still higher color purity, the equipment A showed the operation stability which increased compared with the equipment B. So, the blue discharge OLED of this invention is preferred about potential technical application compared with the equipment of conventional technology. It is because they can give much more good performance if it becomes what.

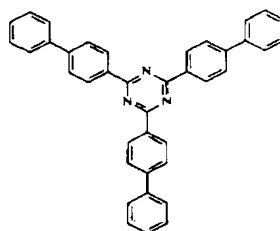
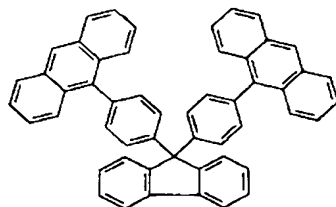
Embodiment 2

A structure ITO anode. (50 nm) / the third class of NPB aromatic amine compound electron hole transporting bed. (30 nm) / SBPA anthracene derivative compound -- an emitter layer (42 nm) / the first electron transport layer (10 nm) of a TBT triazine derivative compound / the second electron transport layer (20 nm) of an AlQ₃ quinoline derivative compound / Mg:Ag cathode

(Mg:Ag 9:1 volume ratios) A 200-nm organic luminescent device (called the equipment C among this Description) was processed. The molecular structure of SBPA and TBT is as follows.

[0045]

[Chemical formula 19]



[0046]

The structure of other organic compounds was shown in the previous embodiment.

That equipment was processed by vacuum adhesion by the base pressure of the 5×10^{-6} torr, and heat evaporation of all the organic layers and cathodes was carried out in this case on the ITO covering glass support body front-washed using UV-ozone cleaning.

Current density = when it operated using 25.00 mA/cm^2 , the equipment produced the color purity which is equivalent to coordinates (0.158, 0.149) with blue discharge and the CIE chart of the strength of 451 cd/m^2 . The operation voltage needed for operating equipment on these conditions was 10.3 volts.

[0047]

Comparative example 2 (conventional technology)

A structure ITO anode. (50 nm) / NPB3 -- a class aromatic amine compound electron hole transporting bed (30 nm) / SBPA anthracene derivative compound emitter layer (42 nm) / AlQ_3 quinoline derivative compound electron transport layer (20 nm) / Mg:Ag cathode (Mg:Ag 9:1 volume ratios) A 200-nm organic luminescent device (called the equipment D among this Description) was processed.

The structure of the organic compound was shown in the previous embodiment.

That equipment was processed by vacuum adhesion by the base pressure of the 5×10^{-6} torr, and heat evaporation of all the organic layers and cathodes was carried out in this case on the ITO covering glass support body front-washed using UV-ozone cleaning.

Current density = when it operated using 25.00 mA/cm^2 , the equipment produced the color purity which is equivalent to coordinates (0.189, 0.261) with blue discharge and the CIE chart of the strength of 322 cd/m^2 . The operation voltage needed for operating equipment on these conditions was 9.3 volts.

If the performance of the equipment C (this invention) and D (conventional technology) is compared, it is clear equipment's C to have indicated that still higher color purity was clear from CIE coordinates and the especially still smaller value about "y" (namely, the second) coordinates.

In addition, it is shown that the equipment A and C is not limited to an anthracene derivative compound with specific performance by which equipment of an embodiment of this invention was improved, or a specific triazine derivative compound. Rather, use of various anthracene derivative compounds and a triazine derivative compound can be used for producing an organic luminescent device which has the improved performance.

[0048]

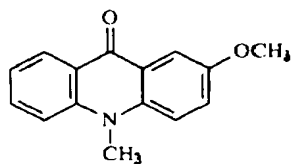
Embodiment 3

A structure ITO anode. (50 nm) / the third class of NPB aromatic amine compound electron hole transporting bed. (30 nm) / acridone photogene. The SBPA anthracene derivative compound emitter layer (42 nm) / the first electron transport layer (10 nm) of a TBT triazine derivative compound / the second electron transport layer of an AlQ_3 quinoline derivative compound doped by (1.6 volume [of an emitter layer] %). An organic luminescent device (called the equipment E among this Description) of (20 nm) / Mg:Ag cathode (9:1 volume ratios of Mg:Ag, 200 nm) was processed.

Molecular structure of an acridone blue light substance

[0049]

[Chemical formula 20]



[0050]

An acridone blue light substance

It comes out.

Structure of other organic compounds was shown in a previous embodiment.

That equipment was processed by vacuum adhesion by a base pressure of a 5×10^{-6} torr, and heat evaporation of all the organic layers and cathodes was carried out in this case on an ITO covering glass support body front-washed using UV-ozone cleaning.

Current density = when it operated using 25.00 mA/cm^2 , the equipment produced color purity which is equivalent to coordinates (0.158, 0.112) with blue discharge and a CIE chart of strength of 410 cd/m^2 . Operation voltage needed for operating equipment on these conditions was 10.4 volts.

Comparison of color purity coordinates of the equipment C and E shows that color purity of equipment of this invention can be further improved by adding a blue light substance in a luminescence zone.

[0051]

Embodiment 4

The first pass of a luminescence zone containing a structure ITO anode (50 nm) / CuPc porphyrin compound buffer layer (15 nm) / the third class of NPB aromatic amine compound electron hole transporting bed (30 nm) / SBPA (2 nm), And the secondary layer (35 nm) / the first electron transport layer (8 nm) of a TBT triazine derivative compound / the second electron transport layer of T1 triazine-derivative compound of a luminescence zone containing a mixture of a SBPA anthracene derivative compound and a TBT triazine derivative compound. A group (called equipment F-i-F-iii among this Description) of an organic luminescent device of (25 nm) / Mg:Ag cathode (9:1 volume ratios of Mg:Ag, 200 nm) was processed.

Molecular structure of an organic compound was shown in a previous embodiment.

At equipment F-i, a SBPA:TBT ratio in a secondary layer of a luminescence zone is 100:0 (volume reference), namely, there is no TBT, and in equipment F-ii. A SBPA:TBT ratio in a secondary layer of a luminescence zone was 95:5 (volume reference), and a SBPA:TBT ratio in a secondary layer of a luminescence zone was 75:25 (volume reference) in equipment F-iii.

That equipment was processed by vacuum adhesion by a base pressure of a 5×10^{-6} torr, and heat evaporation of all the organic layers and cathodes was carried out in this case on an ITO covering glass support body front-washed using UV-ozone cleaning.

Current density = strength of equipment F-i, F-ii, and F-iii fell only 40% of early strength, 30%, and 23% after continuous running of 100 hours by 31.25 mA/cm^2 .

So, it turns out that use of an anthracene derivative compound in a luminescence zone and a mixture of a triazine derivative compound improves performance of equipment of this invention further, and those operation stability may be increased especially. It turns out that a certain mixture ratio may bring about the further increase of device operation stability rather than other ratios.

[0052]

Embodiment 5

A structure ITO anode. (50 nm) / CuPc porphyrin compound buffer layer. The mixture (1:1 volume ratios) luminous layer (25 nm) / BH2 anthracene-derivative compound of (15 nm) / the third class of NPB aromatic amine compound electron hole transporting bed (50 nm) / BH2 anthracene-derivative compound, and the third class of NPB aromatic amine charge transport compound. The first pass (5 nm) of an electron transportation zone to include and an organic luminescent device (called the equipment G among this Description) of the secondary layer (20 nm) / Mg:Ag cathode of an electron transportation zone containing T1 triazine-derivative compound (9:1 volume ratios of Mg:Ag, 200 nm) were processed.

Structure of an organic compound was shown in a previous embodiment.

That equipment was processed by vacuum adhesion by a base pressure of a 5×10^{-6} torr, and heat evaporation of all the organic layers and cathodes was carried out in this case on an ITO covering glass support body front-washed using UV-ozone cleaning.

[0053]

Current density = when it operated using 31.25 mA/cm^2 , the equipment produced color purity which is equivalent to coordinates (0.145, 0.108) with blue discharge and a CIE chart of strength of 200 cd/m^2 . Operation voltage needed for operating equipment on these conditions was 8.1 volts. Attenuation of discharge strength was only about 10% of early strength after continuous running of 600 hours in this current density under a nitrogen atmosphere.

So, it turns out that the use of an anthracene derivative compound in an electron transportation zone, and a triazine derivative compound, an anthracene derivative compound in a luminescence zone together and a mixture of charge transport material can give a blue organic luminescent device which has pure blue discharge and the outstanding operation stability.

From the above-mentioned embodiment, it can be concluded that the blue discharge OLED of this invention is further suitable for potential technical application. It is because they can give good performance compared with the other blue discharge OLED if it becomes what.

[Brief Description of the Drawings]

[Drawing 1] The front view of the first embodiment of this invention is shown.

[Drawing 2] The front view of the second embodiment of this invention is shown.

[Drawing 3] The front view of the third embodiment of this invention is shown.

[Explanations of letters or numerals]

110, 210, 310-OLED

120, a 320-anode

The 220-first electrode

130, 230, a 330-luminous region

140, a 340-cathode

230A-charge transport zone

230B, a 330B-luminescence zone

The 240-second electrode

330A-electron hole transportation zone

A 330C-electron transportation zone

[Translation done.]

* NOTICES *

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- 3.In the drawings, any words are not translated.

TECHNICAL FIELD

[Field of the Invention]

This inventions are parents' U.S. patent application 10th / continuation-in-part application of No. 207,687 (it applied on July 26, 2002), and a preference is claimed after this.

[0002]

[Translation done.]

* NOTICES *

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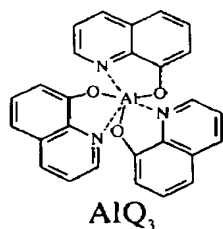
PRIOR ART

(Conventional technology)

A structure ITO anode. (50 nm) / CuPc porphyrin compound buffer layer. (15 nm) / NPB3 -- class aromatic amine compound electron hole transporting bed (30 nm) / BH2 anthracene-derivative compound emitter layer (30 nm) / AlQ₃ quinoline type metal chelate derivative compound electron transport layer (20 nm) / Mg:Ag cathode (Mg:Ag 9:1 volume ratios) A 200-nm organic luminescent device (called the equipment B among this Description). Molecular structure of AlQ₃

[0043]

[Chemical formula 18]



[0044]

It comes out.

Molecular structure of an organic compound of all the others was shown in a previous embodiment.

That equipment was processed by vacuum adhesion by a base pressure of a 5×10^{-6} torr, and heat evaporation of all the organic layers and cathodes was carried out in this case on an ITO covering glass support body front-washed using UV-ozone cleaning.

Current density = when it operated using 31.25 mA/cm^2 , the equipment produced color purity which is equivalent to coordinates (0.154, 0.114) with blue discharge and a CIE chart of strength of 390 cd/m^2 . Operation voltage needed for operating equipment on these conditions was 8.3 volts. After continuous operation of 60 hours, attenuation of discharge strength was about 10% of early strength in this current density under a nitrogen atmosphere.

If performance of the equipment A (this invention) and B (conventional technology) is compared, it is clear equipment's A to have indicated that still higher color purity was clear from CIE coordinates and an especially still smaller value about "y" (namely, the second) coordinates. High color purity of the equipment A actually satisfied NTSC engineering specification (the NTSC standard about blue coordinates is (0.14 and 0.08)). Clearly, the equipment B does not satisfy these standards. In addition to still higher color purity, the equipment A showed operation stability which increased compared with the equipment B. So, the blue discharge OLED of this invention is preferred about potential technical application compared with equipment of conventional technology. It is because they can give much more good performance if it becomes

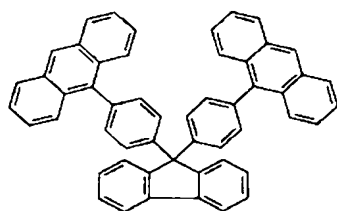
what.

Embodiment 2

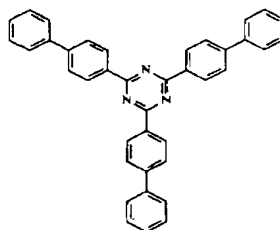
A structure ITO anode. (50 nm) / the third class of NPB aromatic amine compound electron hole transporting bed. (30 nm) / SBPA anthracene derivative compound -- an emitter layer (42 nm) / the first electron transport layer (10 nm) of a TBT triazine derivative compound / the second electron transport layer (20 nm) of an AlQ₃ quinoline derivative compound / Mg:Ag cathode (Mg:Ag 9:1 volume ratios) A 200-nm organic luminescent device (called the equipment C among this Description) was processed. The molecular structure of SBPA and TBT is as follows.

[0045]

[Chemical formula 19]



SBPA



TBT

[0046]

The structure of other organic compounds was shown in the previous embodiment.

That equipment was processed by vacuum adhesion by the base pressure of the 5×10^{-6} torr, and heat evaporation of all the organic layers and cathodes was carried out in this case on the ITO covering glass support body front-washed using UV-ozone cleaning.

Current density = when it operated using 25.00 mA/cm^2 , the equipment produced the color purity which is equivalent to coordinates (0.158, 0.149) with blue discharge and the CIE chart of the strength of 451 cd/m^2 . The operation voltage needed for operating equipment on these conditions was 10.3 volts.

[0047]

Comparative example 2 (conventional technology)

A structure ITO anode. (50 nm) / NPB3 -- a class aromatic amine compound electron hole transporting bed (30 nm) / SBPA anthracene derivative compound emitter layer (42 nm) / AlQ₃ quinoline derivative compound electron transport layer (20 nm) / Mg:Ag cathode (Mg:Ag 9:1 volume ratios) A 200-nm organic luminescent device (called the equipment D among this Description) was processed.

Structure of an organic compound was shown in a previous embodiment.

That equipment was processed by vacuum adhesion by a base pressure of a 5×10^{-6} torr, and heat evaporation of all the organic layers and cathodes was carried out in this case on an ITO covering glass support body front-washed using UV-ozone cleaning.

Current density = when it operated using 25.00 mA/cm^2 , the equipment produced color purity which is equivalent to coordinates (0.189, 0.261) with blue discharge and a CIE chart of strength of 322 cd/m^2 . Operation voltage needed for operating equipment on these conditions was 9.3 volts.

If performance of the equipment C (this invention) and D (conventional technology) is compared, it is clear equipment's C to have indicated that still higher color purity was clear from CIE coordinates and an especially still smaller value about "y" (namely, the second) coordinates. In addition, it is shown that the equipment A and C is not limited to an anthracene derivative compound with specific performance by which equipment of an embodiment of this invention was improved, or a specific triazine derivative compound. Rather, use of various anthracene

derivative compounds and a triazine derivative compound can be used for producing an organic luminescent device which has the improved performance.

[0048]

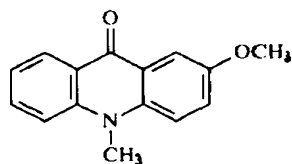
Embodiment 3

A structure ITO anode. (50 nm) / the third class of NPB aromatic amine compound electron hole transporting bed. (30 nm) / acridone photogene. The SBPA anthracene derivative compound emitter layer (42 nm) / the first electron transport layer (10 nm) of a TBT triazine derivative compound / the second electron transport layer of an AlQ₃ quinoline derivative compound doped by (1.6 volume [of an emitter layer] %). The organic luminescent device (called the equipment E among this Description) of (20 nm) / Mg:Ag cathode (9:1 volume ratios of Mg:Ag, 200 nm) was processed.

Molecular structure of an acridone blue light substance

[0049]

[Chemical formula 20]



[0050]

Acridone blue light substance

It comes out.

The structure of other organic compounds was shown in the previous embodiment.

That equipment was processed by vacuum adhesion by the base pressure of the 5×10^{-6} torr, and heat evaporation of all the organic layers and cathodes was carried out in this case on the ITO covering glass support body front-washed using UV-ozone cleaning.

Current density = when it operated using 25.00 mA/cm², the equipment produced the color purity which is equivalent to coordinates (0.158, 0.112) with blue discharge and the CIE chart of the strength of 410 cd/m². The operation voltage needed for operating equipment on these conditions was 10.4 volts.

Comparison of color purity coordinates of the equipment C and E shows that color purity of equipment of this invention can be further improved by adding a blue light substance in a luminescence zone.

[0051]

Embodiment 4

The first pass of a luminescence zone containing a structure ITO anode (50 nm) / CuPc porphyrin compound buffer layer (15 nm) / the third class of NPB aromatic amine compound electron hole transporting bed (30 nm) / SBPA (2 nm), And the secondary layer (35 nm) / the first electron transport layer (8 nm) of a TBT triazine derivative compound / the second electron transport layer of T1 triazine-derivative compound of a luminescence zone containing a mixture of a SBPA anthracene derivative compound and a TBT triazine derivative compound. A group (called equipment F-i-F-iii among this Description) of an organic luminescent device of (25 nm) / Mg:Ag cathode (9:1 volume ratios of Mg:Ag, 200 nm) was processed.

Molecular structure of an organic compound was shown in a previous embodiment.

At equipment F-i, a SBPA:TBT ratio in a secondary layer of a luminescence zone is 100:0 (volume reference), namely, there is no TBT, and in equipment F-ii. A SBPA:TBT ratio in a secondary layer of a luminescence zone was 95:5 (volume reference), and a SBPA:TBT ratio in a secondary layer of a luminescence zone was 75:25 (volume reference) in equipment F-iii.

That equipment was processed by vacuum adhesion by a base pressure of a 5×10^{-6} torr, and heat evaporation of all the organic layers and cathodes was carried out in this case on an ITO

covering glass support body front-washed using UV-ozone cleaning.

Current density = strength of equipment F-i, F-ii, and F-iii fell only 40% of early strength, 30%, and 23% after continuous running of 100 hours by 31.25 mA/cm^2 .

So, it turns out that use of an anthracene derivative compound in a luminescence zone and a mixture of a triazine derivative compound improves performance of equipment of this invention further, and those operation stability may be increased especially. It turns out that a certain mixture ratio may bring about the further increase of device operation stability rather than other ratios.

[0052]

Embodiment 5

A structure ITO anode. (50 nm) / CuPc porphyrin compound buffer layer. The mixture (1:1 volume ratios) luminous layer (25 nm) / BH2 anthracene-derivative compound of (15 nm) / the third class of NPB aromatic amine compound electron hole transporting bed (50 nm) / BH2 anthracene-derivative compound, and the third class of NPB aromatic amine charge transport compound. The first pass (5 nm) of an electron transportation zone to include and an organic luminescent device (called the equipment G among this Description) of the secondary layer (20 nm) / Mg:Ag cathode of an electron transportation zone containing T1 triazine-derivative compound (9:1 volume ratios of Mg:Ag, 200 nm) were processed.

The structure of the organic compound was shown in the previous embodiment.

That equipment was processed by vacuum adhesion by the base pressure of the 5×10^{-6} torr, and heat evaporation of all the organic layers and cathodes was carried out in this case on the ITO covering glass support body front-washed using UV-ozone cleaning.

[0053]

Current density = when it operated using 31.25 mA/cm^2 , the equipment produced the color purity which is equivalent to coordinates (0.145, 0.108) with blue discharge and the CIE chart of the strength of 200 cd/m^2 . The operation voltage needed for operating equipment on these conditions was 8.1 volts. Attenuation of discharge strength was only about 10% of early strength after continuous running of 600 hours in this current density under a nitrogen atmosphere. So, it turns out that the use of the anthracene derivative compound in an electron transportation zone, and a triazine derivative compound, the anthracene derivative compound in a luminescence zone together and the mixture of charge transport material can give the blue organic luminescent device which has pure blue discharge and the outstanding operation stability. From the above-mentioned embodiment, it can be concluded that the blue discharge OLED of this invention is further suitable for potential technical application. It is because they can give good performance compared with the other blue discharge OLED if it becomes what.

[Translation done.]

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TECHNICAL PROBLEM

[Problem to be solved by the invention]

However, performance of the blue discharge OLED is improved, those operation stability is increased still more specially, there is a request raise color purity, and this invention tackles it.
[0003]

[Translation done.]

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MEANS

[Means for solving problem]

Set this invention in the embodiment.

Anode,

a cathode -- and

Formula I (A), (1) – I (A), (11), Equipment with which it is equipment including the luminous region between a cathode and an anode, and the luminous region contains an anthracene derivative compound and a triazine derivative compound; The anthracene derivative compound, It is attained by providing the equipment chosen from the group as which it is chosen out of the group which consists of formula I (B), formula I (C), and formula I (D) and, which a triazine derivative compound becomes [the formula II (A), II (B), II (C) and II (D), (a formula and substituent of these being explained in this Description), and].

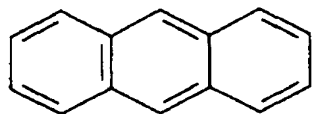
[0004]

[Mode for carrying out the invention]

- (1) Generally the term "layer" shows the single coating which has a constituent in which the constituents of an adjacent layer differ.
- (2) The term "field" expresses a monolayer, two or more layers, for example, two-layer, three layers or more layers than it, and/or one or more "zones."
- (3) The term of the "zone" used about a charge transport zone (namely, an electron hole transportation zone and an electron transportation zone) and a luminescence zone expresses the single functional field in a monolayer, two or more layers, and a layer, or two or more functional fields in a layer.
- (4) The structural formula of the following [term / of an anthracene derivative compound]

[0005]

[Chemical formula 14]



I

[0006]

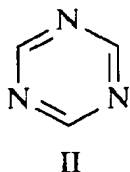
The family of the related non-substituted compound and substituted compound containing all of the same structural unit of the three condensation benzene rings that is alike and is expressed more is expressed, and the example of illustration of an anthracene derivative compound is shown in this Description in this case.

Any three of the CH atoms of benzene the term of a triazine derivative compound (5) A continuation style or a discontinuous style, For example, the family of a related non-substituted compound and substituted compound including all the same structural units of the aromatic heterocycle replaced with the nitrogen atom is expressed with 1, the 2 or 3rd place, 1, the 2 or

4th place, 1, the 2 or 5th place, 1, the 2 or 6th place or 1, and the 3 or 5th place. The substitution by a nitrogen atom is a formula.

[0007]

[Chemical formula 15]



[0008]

It may be 1 and the 3 or 5th place, and the example of illustration of a triazine derivative compound is shown in this Description in this case so that it may be alike and may be expressed more.

(6) the operative condition equally regarded as the layer containing an anthracene derivative compound and/or a triazine derivative compound being a portion on the function of an electrode or other nonluminescent fields, or physics -- setting like and, The facilities in here are that such a layer containing an anthracene derivative compound and/or a triazine derivative compound is considered to be a part of luminous region.

(7) The term "non-anthracene and non-triazine derivative compound" expresses compounds other than an anthracene derivative compound and a triazine derivative compound.

This organic luminescent device ("OLED") contains a kind of at least anthracene derivative compound and a kind of triazine derivative compound at least in a luminous region. It may be used for all suitable layer order forewords and a layer presentation attaining this invention.

The embodiment of the first illustration is shown in drawing 1, and among a figure, OLED 110 is the shown order and contains the anode 120, the luminous region 130, and the cathode 140.

The embodiment of the second illustration is shown in drawing 2, and among a figure, OLED 210 is the shown order and contains luminous region 230; and the second electrode 240 including the first electrode 220; luminescence zone 230B and the charge transport zone 230A. The first electrode may be a cathode and, on the other hand, the second electrode is an anode. The first electrode may be an anode and, on the other hand, the second electrode is a cathode. When the second electrode is an anode, a charge transport zone may be an electron hole transportation zone. When the second electrode is a cathode, a charge transport zone may be an electron transportation zone.

[0009]

the embodiment of the third illustration is shown in drawing 3, and OLED 310 is the shown order among a figure -- anode 320; -- luminous region 330; and the cathode 340 including the arbitrary buffer layer 322; electron hole transportation zones 330A, the luminescence zone 330B, and the electron transportation zone 330C are included.

Since it is expedient, the base material is not shown in drawing 1-3. However, it is understood that a base material contacts two electrodes, for example, and may be arranged by all the suitable places in shown OLED.

A kind of triazine derivative compound at least may exist as more compounds than a kind, two sorts, three sorts, or it. When two or more sorts of triazine derivative compounds exist, it may be independently arranged all over the field where a layer which may be in the state where they may be the mixtures of an equal ratio or the ratio which is not equal, or a triazine derivative compound is not mixed, for example, is different differs from a monolayer. In an embodiment, a kind of triazine derivative compound at least may be considered to be an electron transport substance. It is because transportation of an electron is larger than transportation of an electron hole by a triazine derivative compound if it becomes what. an operative condition -- it sets like and some triazine derivative compounds are electron transportation objects -- in addition -- it may be a substance which a blue emitter, i.e., an electron hole, and an electron combine, and

may bring about discharge of the light of the blue area of a visible spectrum.

[0010]

A kind of anthracene derivative compound at least may exist as more compounds than a kind, two sorts, three sorts, or it. When two or more sorts of anthracene derivative compounds exist, it may be independently arranged all over a field where a layer which may be in a state where they may be the mixtures of an equal ratio or a ratio which is not equal, or an anthracene derivative compound is not mixed, for example, is different from a monolayer. A kind of anthracene derivative compound at least is a mold of an organic electrophotoluminescence substance which may be considered to be a substance which a blue emitter, i.e., an electron hole, and an electron combine, and may bring about discharge of light of a blue area of a visible spectrum. In an embodiment, a level that some anthracene derivative compounds are insufficient again and remarkable which is good or was excellent conveys both an electron hole, an electron, or an electron hole and an electron. In an embodiment, since anthracene derivative compounds may be both a blue emitter and an electric charge conductor, this double character makes flexibility of a certain grade possible at arrangement of an anthracene derivative compound in OLED.

[0011]

At least a kind of anthracene derivative compound and a kind of triazine derivative compound at least The book OLED. For example, OLED arrangement of the following illustration (when two or more sorts of anthracene derivative compounds exist in OLED) Such an anthracene derivative compound may be mutually the same, moreover -- it may differ --; -- when two or more sorts of triazine derivative compounds exist in OLED again, such a triazine derivative compound may be mutually the same, and may exist all over a bilayer or layers much more larger than it which may be different, a zone, or a field.

- (1) An anode / luminescence zone (anthracene derivative compound) / electron transportation zone (triazine derivative compound) / cathode
- (2) An anode / luminescence zone (anthracene derivative compound + triazine derivative compound) / electron transportation zone (non-anthracene and non-triazine derivative compound) / cathode
- (3) An anode / luminescence zone (anthracene derivative compound + triazine derivative compound) / electron transportation zone (triazine derivative compound) / cathode
- (4) An anode / luminescence zone (anthracene derivative compound + triazine derivative compound) / electron transportation zone (anthracene derivative compound + triazine derivative compound) / cathode
- (5) An anode / luminescence zone (anthracene derivative compound) / electron transportation zone (anthracene derivative compound + triazine derivative compound) / cathode

[0012]

- (6) An anode / luminescence zone (anthracene derivative compound) / electron transportation zone (the first pass of an anthracene derivative compound + triazine derivative compound, and secondary layer of a triazine derivative compound) / cathode
- (7) An anode / luminescence zone (anthracene derivative compound) / electron transportation zone (secondary layer of the first pass of an anthracene derivative compound + triazine derivative compound, non-anthracene, and a non-triazine derivative compound) / cathode
- (8) An anode / electron hole transportation zone (anthracene derivative compound) / luminescence zone (anthracene derivative compound + triazine derivative compound) / electron transportation zone (triazine derivative compound) / cathode
- (9) An anode / electron hole transportation zone (anthracene derivative compound) / luminescence zone (anthracene derivative compound + triazine derivative compound) / electron transportation zone (non-anthracene and non-triazine derivative compound) / cathode
- (10) An anode / electron hole transportation zone (anthracene derivative compound) / luminescence zone (anthracene derivative compound + triazine derivative compound) / cathode
- (11) An anode / electron hole transportation zone (anthracene derivative compound) / luminescence zone (triazine derivative compound) / cathode
- (12) An anode / electron hole transportation zone (anthracene derivative compound) /

luminescence zone (triazine derivative compound) / electron transportation zone (triazine derivative compound) / cathode

(13) An anode / electron hole transportation zone (anthracene derivative compound) / luminescence zone (triazine derivative compound) / electron transportation zone (non-anthracene and non-triazine derivative compound) / cathode

(14) An anode / electron hole transportation zone (anthracene derivative compound) / luminescence zone (non-anthracene and non-triazine derivative compound) / electron transportation zone (triazine derivative compound) / cathode.

[0013]

In 6 and 7, a layer of an anthracene derivative compound + triazine derivative compound is equally regarded as it being a part of luminescence zone.

In 1-7, arrangement may also include further an electron hole transportation zone (an anode is adjoined) which may also contain an anthracene derivative compound and/or non-anthracene, and a non-triazine derivative compound as occasion demands.

In 8-14, arrangement may also contain further non-anthracene and a non-triazine derivative compound all over an electron hole transportation zone (an anode is adjoined) as occasion demands.

A luminous region containing an anthracene derivative compound and a triazine derivative compound may be a bilayer, three layers, or more layers than it much more. An anthracene derivative compound and a triazine derivative compound about a monolayer luminous region For example, two functional field: luminescence zones. (For example, an anthracene derivative compound + triazine derivative compound) and an electron transportation zone. Layer thickness is crossed and it can adhere by various concentration so that (for example, an anthracene derivative compound + triazine derivative compound) may arise, In this case, concentration of an anthracene derivative compound in an electron transportation zone is smaller than inside of a luminescence zone, or completely absent from an electron transportation zone by necessity, for example. In an embodiment, a monolayer photogen which contains a mixture of an anthracene derivative compound and a triazine derivative compound with fixed concentration in it is provided. The following [luminous region / multilayer] for example,: A luminous layer between luminous layer; and an electron hole transporting bed in contact with a charge transport layer, and an electron transport layer may also be included.

[0014]

A luminescence zone may also contain the mixture of a single anthracene derivative compound or two or more sorts of anthracene derivative compounds. When the mixture of two or more sorts of anthracene derivative compounds is used, an anthracene derivative compound may exist in all suitable weight ratios, for example, an equal quantity, or the quantity which is not equal. A kind of compound in a mixture may exist in the quantity of the range from 0.1 weight % to 99.9 weight %, for example, and the remainder is a compound more than other kinds. In addition to the anthracene derivative compound more than a kind, charge transport material is based on a luminescence zone, For example, it may exist all over a luminescence zone by the concentration of the range from 0 weight % to about 95 weight %, and the remainder is an anthracene derivative compound more than a kind of the concentration of the range from 100 weight % to about 5 weight % on the basis of a luminescence zone.

A luminescence zone may also contain the mixture of a single triazine derivative compound or two or more sorts of triazine derivative compounds. When the mixture of two or more sorts of triazine derivative compounds is used, a triazine derivative compound may exist in all suitable weight ratios, for example, an equal quantity, or the quantity which is not equal. A kind of compound in a mixture may exist in the quantity of the range from 0.1 weight % to 99.9 weight %, for example, and the remainder is a compound more than other kinds. In addition to the triazine derivative compound more than a kind, charge transport material is based on a luminescence zone, For example, it may exist all over a luminescence zone by the concentration of the range from 0 weight % to about 95 weight %, and the remainder is a triazine derivative compound more than a kind of the concentration of the range from 100 weight % to about 5 weight % on the basis of a luminescence zone.

[0015]

A luminescence zone may also contain the anthracene derivative compound more than a kind, and the mixture of the triazine derivative more than a kind. When two or more sorts of mixtures, the anthracene derivative compound more than a kind and the triazine derivative compound more than a kind, are used, Each of the anthracene derivative compound more than a kind and the triazine derivative compound more than a kind may exist in all suitable weight ratios, for example, an equal quantity, or the quantity which is not equal. A kind of compound in a mixture may exist in the quantity of the range from 0.1 weight % to 99.9 weight %, for example, and the remainder is a compound more than other kinds. In addition to the anthracene derivative compound more than a kind, and the triazine derivative compound more than a kind, charge transport material is based on a luminescence zone, For example, it may exist all over a luminescence zone by the concentration of the range from 0 weight % to about 95 weight %, and the remainders are an anthracene derivative compound more than a kind of the concentration of the range from 100 weight % to about 5 weight %, and a triazine derivative compound more than a kind on the basis of a luminescence zone.

In an embodiment, a luminescence zone may also contain the non-anthracene and the non-triazine derivative compound more than a kind in all suitable weight ratios, for example, an equal quantity, or the quantity which is not equal. Since the strength of the color of light or the purity of a color emitted compared with the luminescence zone which does not contain the non-anthracene and the non-triazine derivative compound more than such a kind is influenced, the non-anthracene and the non-triazine derivative compound more than these kinds may be added by the luminescence zone. The blue discharge OLED is manufactured in the embodiment of this invention. In another embodiment, when OLED which emits another color adds the non-anthracene and the non-triazine derivative compound more than a kind in a luminescence zone and changes blue with use of the suitable substance in a luminous region to another color, for example, it may be manufactured.

[0016]

A charge transport zone (an electron hole transportation zone or an electron transportation zone is not asked) contains a mixture of two or more sorts of charge transport material of single charge transport material, all suitable weight ratios, for example, an equal quantity, or quantity that is not equal. A kind of compound in a mixture may exist in quantity of a range from 0.1 weight % to 99.9 weight %, for example, and the remainder is a compound more than other kinds. A charge transport zone may also contain an anthracene derivative compound more than a kind, a triazine derivative compound more than a kind, non-anthracene more than a kind and non-triazine compounds, or all these mixtures.

A layer of OLED may be transparent or opaque according to a field of OLED facing those who see. A substance of illustration will be explained to construction of OLED of this invention. A transparent base material may also include substantially various suitable materials containing a polymer component, glass, quartz, etc., for example. Although polyester (registered trademark), for example, a miler, polycarbonate, polyacrylate, polymethacrylate, polysulfone, etc. are mentioned as a suitable polymer component, it is not limited to these. Other support materials may be chosen again.

[0017]

A base material may have the thickness from about 25 micrometers to about 1,000 micrometers still more specially from about 10 micrometers to about 5,000 micrometers.

An anode may also contain the suitable charge of a positive charge injecting material, for example, indium tin oxide, (ITO), silicon, a tin oxidation thing and the metal that has a work function of the range from about 4 eV to about 6 eV, for example, gold, platinum, and palladium. Although not less than about 4 eV of conductive carbon, pi conjugated polymer, for example, poly aniline, a polythiophene, polypyrrole, etc. which have a work function from about 4 eV to about 6 eV especially are mentioned as other materials suitable for an anode, for example, it is not limited to these. A transparent anode substantially the work function of indium tin oxide (ITO) and the range from about 4 eV to about 6 eV, for example, including the metal which it has, for example, gold, palladium, etc. from about 10A to about 200A, The very thin substantially

transparent metal layer which has the thickness from about 30Å to about 100Å especially may also be included. The thickness of an anode may be a range from about 10Å to about 50,000Å, and it depends for the desirable range on the electric constant and optical constant of an anode material. The range of one illustration of the thickness of an anode is from about 300Å to about 3,000Å.

[0018]

A cathode may also include all the suitable electron injection materials, for example, metal, containing the high work function ingredient which has a work function from about 4 eV to about 6 eV, for example, metal, and the low work function ingredient which has a work function from about 2 eV to about 4 eV, for example, for example, metal, for example. A cathode may also include the combination of low work function (less than about 4 eV) metal and the metal of at least a kind of others. The effective ratio of the metal of the second or others versus a low work function metal is from less than about 0.1 weight % to about 99.9 weight %. As an example of illustration of a low work function metal, alkaline metal, for example, lithium, or sodium; 2A fellows or alkaline-earth metals, For example, although the group III metal, for example, a scandium, containing beryllium, magnesium, calcium, or barium; rare-earth metal, and an actinide group metal, yttrium, a lanthan, cerium, europium, a terbium, or actinium is mentioned, it is not limited to these. Lithium, magnesium, and calcium are desirable low work function metals. It is a cathode material desirable although Mg-Ag alloy cathode forms a cathode in an embodiment. Other special cathodes contain a metal-organicity mixed layer (MOML). A cathode can be formed from a lithium alloy with other high work function metal, for example, aluminum, and indium.

[0019]

The metal in which a transparent cathode has a work function of the range from about 2 eV to about 4 eV substantially, For example, Mg, Ag, aluminum, Ca, In, Li(s), and those alloys. For example, Mg containing Ag of Mg of about 80 to 95 volume % and about 20 – about 5 volume % : An Ag alloy, And Li which contains Li of aluminum of volume [about 90 to 99] % and about 10 – volume [about 1] %, for example: The very thin substantially transparent metal layer which has the thickness from about 30Å to about 100Å especially from about 10Å to about 200Å may also be included, including an aluminum alloy etc.

The thickness of a cathode may be a range from about 10 nanometers to about 1,000 nanometers, for example.

The anode and cathode which are used for the book OLED may be a monolayer, respectively, or may also contain two-layer, three layers, or more layers than it. For example, an electrode may also contain an electric charge pouring layer (namely, an electronic injection layer or a hole injection layer) and a capping layer. However, in an embodiment, it may be thought that an electric charge pouring layer differs from an electrode. The metal in which an electronic injection layer has a work function of the range from about 2 eV to about 4 eV, For example, Mg, Ag, aluminum, Ca, In, Li(s), and those alloys. For example, Mg containing Ag of Mg of about 80 to 95 volume % and about 20 – about 5 volume % : An Ag alloy, And Li which contains Li of aluminum of volume [about 90 to 99] % and about 10 – volume [about 1] %, for example: The very thin substantially transparent metal layer which has the thickness from about 30Å to about 100Å especially from about 10Å to about 200Å may also be included, including an aluminum alloy etc. An electronic injection layer may also include an oxide material or a very thin insulating material like an alkali metal compound which was indicated to US,5,457,565,B, 5,608,287, and 5,739,635 again.

[0020]

A hole injection layer may also contain the suitable charge of a positive charge injecting material, for example, indium tin oxide, (ITO), silicon, a tin oxidation thing and the metal that has a work function of the range from about 4 eV to about 6 eV, for example, gold, platinum, and palladium. Although not less than about 4 eV of conductive carbon, pi conjugated polymer, for example, poly aniline, a polythiophene, polypyrrole, etc. which have a work function from about 4 eV to about 6 eV especially are mentioned as other materials suitable for a hole injection layer, for example, it is not limited to these. A transparent hole-injection material may also contain substantially the very thin substantially transparent metal layer which has the thickness from about 30Å to about

100A especially from about 10A to about 200A, including the metal which has a work function of the range from about 4 eV to about 6 eV, for example, gold, palladium, etc. The additional suitable form of the hole injection layer is indicated by US,4,885,211,B and 5,703,436.

The capping layer of an anode and/or a cathode may be contained in order to increase thermal stability, and to increase environmental stability and to improve the performance of an organic luminescent device by the method of/or others of a certain kind. The example of the capping layer which can use the thermal stability of an organic luminescent device for increasing is a layer containing SiO, SiO₂, or these mixtures. The example of the capping layer which can use the environmental stability of an organic luminescent device for increasing is a layer containing stable metal, for example, Ag, aluminum, In, or Au. Another example of the capping layer which can use the environmental stability of an organic luminescent device for increasing is a layer which contains a low work function metal which was indicated to US,5,059,861,B, for example. The thickness of a capping layer may be a range from [from about 20 nanometers to about 5,000 nanometers] about 50 nanometers to 500 nanometers, for example.

[0021]

A buffer layer may also include the material which has the hole-injection characteristic of a certain kind and transport properties, and it is chosen so that device performance may be improved. As a suitable material which can be used into a buffer layer, a semiconductor organic material. For example, a porphyrin derivative like 1,10,15,20-tetraphenyl-21 H,23H-porphyrin copper (II) indicated by US,4,356,429,B; A copper phthalocyanine, copper tetramethyl phthalocyanine; -- zinc phthalocyanine; -- titanium oxide phthalocyanine; -- magnesium phthalocyanine etc. are mentioned and a copper phthalocyanine is one desirable example. The mixture of such materials and other suitable materials can use it again. As a suitable material of others which can be used into a buffer layer, a semiconductor and insulating metallic compounds, For example, MgO, aluminum₂O₃, BeO, BaO, AgO, SrO, SiO, SiO₂, ZrO₂, CaO, Cs₂O, Halogenated metal like metallic-oxide; like Rb₂O, Li₂O, K₂O, and Na₂O and LiF, KCl, NaCl, CsCl, CsF, and KF is mentioned. A buffer layer may have the thickness of the range from [from about 5 nm to about 25 nm] about 1 nm to about 5 nm from about 1 nm to about 100 nm.

As an anthracene derivative compound of illustration, an anthracene derivative compound of a compound of EP 1009044 A2, general structural-formula I (A), (1) - I (A) and (11) is mentioned.

[0022]

The inside of a formula, substituent R¹, R², R³, R⁴, Independently R⁵ and R⁶, respectively Hydrogen, alkyl of 1-24 carbon atoms, Alkoxy ** triphenylsilyl of 1-9 carbon atoms, aryl of 6-20 carbon atoms (this may be replaced as occasion demands), It is chosen out of a group which consists of heteroaryl (this may be replaced as occasion demands) of 5-24 carbon atoms, halogen, for example, fluoride, chlorine, bromine, and a cyano group. A hetero atom in heteroaryl may be nitrogen, sulfur, or oxygen, for example. A portion from which aryl and heteroaryl are the same as, or differ as occasion demands. For example, the following portion: It may be replaced by alkyl of 1-9 carbon atoms and alkoxy ** halogen of 1-9 carbon atoms, for example, fluoride, chlorine, bromine, cyano group, etc. by more number of times than 1 time, 2 times, or it.

[0023]

What was indicated by US,5,972,247,B is mentioned as an anthracene derivative compound of other illustration, and an anthracene derivative compound of general structural-formula I (B) is indicated there.

the inside of a formula, substituent R⁷, R⁸, R⁹, and R¹⁰ -- respectively -- independent Group 1: Hydrogen or alkyl of 1-24 carbon atoms;

Aryl of the carbon atom of 2:6-20 groups (this may be replaced as occasion demands);

Group 3: Carbon atom required to complete the fused aromatic ring of naphthyl, anthracenyl, pyrenyl, or peri RENIRU;

Heteroaryl of the carbon atom of 4:5-24 groups (this may be replaced as occasion demands);

Group 5: A furil, thienyl, pyridyl, or condensation hetero aromatic ring of kino RINIRU;

The alkoxy group, the amino group, alkylamino group, or arylamino group of the carbon atom of

6:1–24 groups; it reaches.

Group 7: Fluoride, chlorine, bromine, or cyano

It is chosen out of the group, ** and others.

The hetero atom in heteroaryl may be nitrogen, sulfur, or oxygen, for example. The portion from which aryl and heteroaryl are the same as, or differ as occasion demands. For example, the following portion: It may be replaced by the alkyl of 1–9 carbon atoms and alkoxy ** halogen of 1–9 carbon atoms, for example, fluoride, chlorine, bromine, the cyano group, etc. by more number of times than 1 time, 2 times, or it.

[0024]

As an anthracene derivative compound of other illustration, what was indicated by US,5,935,721,B, and the anthracene derivative compound of general structural-formula I (C) are mentioned.

the inside of a formula, substituent R^{11} , R^{12} , R^{13} , and R^{14} -- respectively -- independent

Group 1: Hydrogen or alkyl of 1–24 carbon atoms;

Aryl of the carbon atom of 2:6–20 groups (this may be replaced as occasion demands);

Group 3: Carbon atom required to complete the fused aromatic ring of naphthyl, anthracenyl, pyrenyl, or peri RENIRU;

Heteroaryl (this may be replaced as occasion demands) of the carbon atom of 4:5–24 groups, a furil, thienyl, pyridyl, the condensation hetero aromatic ring of kino RINIRU, and carbon atom required to complete other heterocyclic systems;

The alkoxy group, the amino group, alkylamino group, or arylamino group of the carbon atom of 5:1–24 groups; it reaches.

Group 6: Fluoride, chlorine, bromine, or cyano

It is chosen out of the group, ** and others.

The hetero atom in heteroaryl may be nitrogen, sulfur, or oxygen, for example. The portion from which aryl and heteroaryl are the same as, or differ as occasion demands. For example, the following portion: It may be replaced by the alkyl of 1–9 carbon atoms and alkoxy ** halogen of 1–9 carbon atoms, for example, fluoride, chlorine, bromine, the cyano group, etc. by more number of times than 1 time, 2 times, or it.

One desirable example of these anthracene derivative compounds of general formula I (C) is a 9,10-di-(2-naphthyl) anthracene derivative compound.

[0025]

As another example of an anthracene derivative compound, a compound shown by the formula I (D) is mentioned.

the inside of a formula, R^{15} , and R^{16} -- independent -- hydrogen and 1- alkyl-group and about 6- which has about six carbon atoms -- it is chosen out of a group which consists of an aryl group which has about 30 carbon atoms. Special examples of a substituent about R^{15} and R^{16} are hydrogen, methyl, tert-butyl, a phenyl, naphthyl, etc. X and Y are chosen from a group which consists of an alkoxy group which has an alkyl group which has hydrogen, for example, 1, - a carbon atom of six abbreviation independently and an aryl group which has about six pieces - about 30 carbon atoms -, for example, 1, and a carbon atom of six abbreviation, halogen, a cyano group, etc. Special examples of a substituent about X and Y are hydrogen, methyl, tert-butyl, tert-butoxy, etc.

[0026]

As an example of a triazine derivative compound, a compound indicated by US,6,229,012,B, 6,225,467, and 6,057,048 is mentioned. A triazine derivative compound of illustration is contained by the formula II (A) - II (D), for example.

Ar^1 , Ar^2 , Ar^3 , and Ar^4 are the aryls (this may be replaced as occasion demands) of the carbon atom of 6 - 20 abbreviation independently among a formula, respectively, The aryl may be chosen from the group which consists of a phenyl, stilbenyl, biphenyl, naphthyl, pyridyl, quinolyl, etc., for example. The alkyl group in which an aryl group has 1 - a carbon atom of six abbreviation as occasion demands, for example, For example, it may be replaced by the substituent chosen from the group which consists of the dialkylamino group which has the alkoxy

group which has 1 – a carbon atom of six abbreviation –, for example, 1, and a carbon atom of three abbreviation, halogen, a cyano group, etc. by more number of times than 1 time, 2 times, or it.

$R^{17} - R^{18}$ -- independent -- hydrogen and an aliphatic group, for example, 1-, -- the alkyl group which has about six carbon atoms, for example, 1-, -- being chosen out of the group which consists of the alkoxy group which has about six carbon atoms, halogen, for example, chlorine, and a cyano group

L is a divalent basis which may be chosen from the group which consists of $-C(R'R'')-$, ethylene, $-Si(R'R'')-$, an oxygen atom, a sulfur atom, etc. -- R' and R'' -- respectively -- independent -- a hydrogen atom and 1- the alkyl group containing about ten carbon atoms or 1- it is an alkoxy group containing about ten carbon atoms.

[0027]

A luminous region, especially a luminescence zone may also contain further (the photogene on the basis of the weight of a luminescence zone) from about 0.01 weight % to about 25 weight % as a dopant. The examples of the dopant substance which can be used all over a luminous region are a fluorescent substance, for example, a coumarin, a dicyanomethylene pyran, poly methine, oxa BENZUAN tolan, a xanthene, pyrylium, a carbo still, perylene, etc. Another desirable class of a fluorescent substance is the Quinacridone color. As an example of illustration of the Quinacridone color, US,5,227,252,B, Quinacridone which was indicated by 5,276,381 and 5,593,788, 2-methyl Quinacridone, 2,9-dimethyl Quinacridone, 2-chloro Quinacridone, 2-fluoro Quinacridone, 1,2-benzo Quinacridone, N,N'-dimethyl Quinacridone, N,N'-dimethyl- 2-methyl Quinacridone, N,N'-dimethyl- 2,9-dimethyl Quinacridone, N,N'-dimethyl- 2-chloro Quinacridone, N,N'-dimethyl- 2-fluoro Quinacridone, N,N'-dimethyl- 1,2-benzo Quinacridone, etc. are mentioned. Another class of the fluorescent substance which can be used is condensed ring fluorescent dye. As suitable condensed ring fluorescent dye of illustration, perylene, rubrene, anthracene, coronene, a phenan training center, pyrene, etc. which were indicated by US,3,172,862,B are mentioned. Butadiene which was indicated by US,4,356,429,B and 5,516,577, for example, 1,4-diphenylbutadiene, tetraphenylbutadiene, a stilbene, etc. are mentioned as a fluorescent substance. The example of others of the fluorescent substance which can be used is indicated by US,5,601,903,B.

[0028]

The fluorescent dye by which the luminescence dopant which can be used all over a luminous region was indicated by US,5,935,720,B, For example, 4-(dicyanomethylene)-2-I-propyl-6-(1,1,7,7-tetramethyl JURO lysyl-9-ene yl)-4H-Piran (DCJTB); A lanthanide metal chelate complex, For example, a tris(acetylacetonate) (phenanthroline) terbium, Tris(acetylacetonate) (phenanthroline) europium, And tris(TENOIRU trisfluoro acetate) (phenanthroline) europium, And what [was indicated by Kido and others, "the white light emission organicity electrophotoluminescence equipment which uses a lanthanide complex", Jpn. J. Appl. Phys., 35 volumes, and L394-L396 page (1996)]; and a phosphorescence substance, For example, the organic metallic compound containing the heavy metal atom which brings about strong spin orbit coupling, For example, it is indicated by Baldo and others, "organic phosphorus light emission effective in the altitude from organic electrophotoluminescence equipment", Letters to Nature, 395 volumes, and 151-154 (1998). As a desirable example, 2,3,7,8,12,13,17,18-octaethyl-21H23H-FORUPIN platinum (II) (PtOEP) and fac tris(2-phenylpyridine) iridium ($Ir(ppy)_3$) are mentioned.

[0029]

In addition to a triazine derivative substance and an anthracene derivative substance, a luminous region, especially an electron hole transportation zone may also contain the substance of others more than a kind which has electron hole transport properties again. Polypyrrole which was indicated by US,5,728,801,B as an example of the electron hole transportation substance which can be used all over a luminous region, Poly aniline, poly (phenylenevinylene), a polythiophene, polyarylamine, And those derivatives and a known semiconductor organic substance; A porphyrin derivative, For example, 1,10,15,20-tetraphenyl-21 H,23H-porphyrin copper (II) indicated by US,4,356,429,B; A copper phthalocyanine, copper tetramethyl phthalocyanine; -- zinc

phthalocyanine; -- titanium oxide phthalocyanine; -- magnesium phthalocyanine etc. are mentioned.

[0030]

The special class of the electron hole transportation substance which can be used all over a luminous region is indicated by the third class of aromatic amine, for example, US,4,539,507,B. As the third class of aromatic amine of suitable illustration, a bis(4-dimethylamino 2-methylphenyl) phenylmethane, N,N,N'-bird (p-tolyl) amine, 1,1-bis(4-di-p-tolylamino phenyl)cyclohexane, 1,1-bis(4-di-p-tolylamino phenyl)-4-phenylcyclohexane, N,N'-diphenyl-N,N'-bis(3-methylphenyl)-1,1'-biphenyl 4,4'-diamine, N,N'-diphenyl-N,N'-bis(3-methylphenyl)-1,1'-biphenyl 4,4'-diamine, N,N'-diphenyl-N,N'-bis(4-methoxyphenyl)-1,1'-biphenyl 4,4'-diamine, N,N,N',N'-tetra-p-tolyl 1,1'-biphenyl 4,4'-diamine, Although N,N'-di-1-naphthyl N,N'-diphenyl-1,1'-biphenyl 4,4'-diamine, N,N'-bis(p-biphenyl)-N,N'-diphenylbenzidines (biphenyl TPD), these mixtures, etc. are mentioned, it is not limited to these. The desirable class of the third class aromatic amine which can be used all over a luminous region is a naphthyl substitution benzidine derivative (NPD), for example, N,N'-JI (naphthalene-1-yl)-N,N'-diphenyl-benzidine. Another class of the third class of aromatic amine is polynuclear aromatic amine. As an example of such polynuclear aromatic amines, it is N,N-bis- [4'-(N-phenyl-N-m-tolylamino)-4-biphenyl] Aniline, N,N-bis- [4'-(N-phenyl-N-m-tolylamino)-4-biphenyl] -m-toluidine, N,N-bis- [4'-(N-phenyl-N-m-tolylamino)-4-biphenyl] -p-toluidine,

[0031]

N,N-bis- [4'-(N-phenyl-N-p-tolylamino)-4-biphenyl] Aniline, N,N-bis- [4'-(N-phenyl-N-p-tolylamino)-4-biphenyl] -m-toluidine, N,N-bis- [4'-(N-phenyl-N-p-tolylamino)-4-biphenyl] -p-toluidine, N,N-bis- [4'-(N-phenyl-N-p-chlorophenylamino)-4-biphenyl] -m-toluidine, N,N-bis- [4'-(N-phenyl-N-m-chlorophenylamino)-4-biphenyl] -m-toluidine, N,N-bis- [4'-(N-phenyl-N-m-chlorophenylamino)-4-biphenyl] -p-toluidine, N,N-bis- [4'-(N-phenyl-N-m-tolylamino)-4-biphenyl] -p-chloroaniline, N,N-bis- [4'-(N-phenyl-N-p-tolylamino)-4-biphenyl] -m-chloroaniline, N,N-bis- [4'-(N-phenyl-N-m-tolylamino)-4-biphenyl] A 4,4'-bis[, such as-1-aminonaphthalenes and these mixtures,](9-carbazolyl)-1 and 1'-biphenyl compound, For example, although 4,4'-bis(9-carbazolyl)-1,1'-biphenyl, 4,4'-bis(3-methyl-9-carbazolyl)-1,1'-biphenyl, etc. are mentioned, it is not limited to these.

[0032]

The thing 5 by which the special class of the electron hole transportation substance which can be used all over a luminous region was indicated by US,5,942,340,B and 5,952,115, for example, 5,11-di-naphthyl, 11-dihydroindolo [3, 2-b] Carbazole and the 2,8-dimethyl- 5,11-di-naphthyl 5, 11-dihydroindolo [3, 2-b] Carbazole; it is N,N,N',N'-tetra aryl benzidine (aryl may be chosen from a phenyl, m-tolyl, p-tolyl, m-methoxyphenyl, p-methoxyphenyl, 1-naphthyl, 2-naphthyl, etc.). The example of illustration of N,N,N',N'-tetra aryl benzidine N,N'-di-1-naphthyl N,N'-diphenyl-1,1'-biphenyl 4,4'-diamine (this is still more preferred), It is N,N'-bis(3-methylphenyl)-N,N'-diphenyl-1,1'-biphenyl 4,4'-diamine and N,N'-bis(3-methoxyphenyl)-N,N'-diphenyl-1,1'-biphenyl 4,4'-diamine etc.

[0033]

In an embodiment, a luminous region may also contain the non-anthracene and the non-triazine derivative compound more than a kind which has desired character, for example, the electron transportation characteristic, and/or luminescent characteristic. In an embodiment, some the non-anthracenes and the non-triazine derivative compounds of the following illustration may have the electron transportation characteristic and/or a luminescent characteristic, In this way, :Polyful Oren who may be useful all over a luminous region (for example, a luminescence zone and/or an electron transportation zone), For example, poly (9,9-di-n-octylfluorene-2,7-diyl), poly (the copolymer containing 2,8- (6,7,12,12-tetra alkyl indeno fluorene) and a fluorene.) Bernius and others [for example,], The proceedings III of the SPIE meeting on organic photogene and equipment, Denver, Colorado, July, 1999, 3797 volumes, and fluorene-Aminco polymer that was indicated by 129 pages.

As other suitable non-anthracenes and non-triazine derivative compounds, metal oxy NOIDO which was indicated by US,4,539,507,B, 5,151,629, 5,150,006, 5,141,671, and 5,846,666 is

mentioned. As a special example of illustration, tris(8-hydroxy kino RINETO) aluminum (Alq₃) and bis(8-hydroxy kino rate)-(4-phenylphenolate) aluminum (Balq) are mentioned. As other examples, tris(8-hydroxy kino RINETO) gallium, Bis(8-hydroxy kino RINETO)magnesium, bis(8-hydroxy kino RINETO)zinc, tris(5-methyl-8-hydroxy kino RINETO) aluminum, tris(7-propyl-8-KINORINO rate) aluminum, a screw [Benzo {f}-8-kino RINETO] Zinc, a screw (10-HIDOROKISHIBENZO) [h]Kino RINETO beryllium etc. are mentioned.

[0034]

Another suitable class of non-anthracene and a non-triazine derivative compound is indicated by the stilbene derivative, for example, US,5,516,577,B. . The further example of non-anthracene and a non-triazine derivative compound was shown in US,5,846,666,B (the indication is thoroughly included in this Description as reference). A metal thio KISHINOIDO compound, for example, bis(8-quinolinethiolate)zinc, Bis(8-quinolinethiolate)cadmium, tris(8-quinolinethiolate) gallium, Tris(8-quinolinethiolate) indium, bis(5-methylquinolinethiolate)zinc, Tris(5-methylquinolinethiolate) gallium, tris(5-methylquinolinethiolate) indium, bis(5-methylquinolinethiolate)cadmium, bis(3-methylquinolinethiolate)cadmium, bis(5-methylquinolinethiolate)zinc, a screw [Benzo {f}-8-quinolinethiolate] Zinc, a screw [3-methylbenzo {f}-8-quinolinethiolate] Zinc, a screw [3,7-dimethylbenzo {f}-8-quinolinethiolate] They are metal thio KISHINOIDO compounds, such as zinc. Special non-anthracene and a non-triazine derivative compound are bis(8-quinolinethiolate)zinc, bis(8-quinolinethiolate)cadmium, tris(8-quinolinethiolate) gallium, tris(8-quinolinethiolate) indium, and a screw. [Benzo {f}-8-quinolinethiolate] It is zinc.

[0035]

Other suitable non-anthracenes and non-triazine derivative compounds are the oxadiazole metal chelates indicated by contained US,5,925,472,B, and are a screw as these substances. [2-(2-hydroxyphenyl)-5-phenyl-1,3,4-oxadiazole rate] Zinc, a screw [2-(2-hydroxyphenyl)-5-phenyl-1,3,4-oxadiazole rate] Beryllium, a screw [2-(2-hydroxyphenyl)-5-(1-naphthyl)-1,3,4-oxadiazole rate] Zinc, a screw [2-(2-hydroxyphenyl)-5-(1-naphthyl)-1,3,4-oxadiazole rate] Beryllium, a screw [5-biphenyl 2-(2-hydroxyphenyl)-1,3,4-oxadiazole rate] Zinc, a screw [5-biphenyl 2-(2-hydroxyphenyl)-1,3,4-oxadiazole rate] Beryllium, a bis(2-hydroxyphenyl)-5-phenyl-1,3,4-oxadiazole rate] Lithium, a screw [2-(2-hydroxyphenyl)-5-p-tolyl 1,3,4-oxadiazole rate] Zinc, a screw [2-(2-hydroxyphenyl)-5-p-tolyl 1,3,4-oxadiazole rate] Beryllium, a screw [5-(p-tert-buthylphenyl)-2-(2-hydroxyphenyl)-1,3,4-oxadiazole rate] Zinc, a screw [5-(p-tert-buthylphenyl)-2-(2-hydroxyphenyl)-1,3,4-oxadiazole rate] Beryllium, a screw [2-(2-hydroxyphenyl)-5-(3-fluorophenyl)-1,3,4-oxadiazole rate] Zinc, a screw [2-(2-hydroxyphenyl)-5-(4-fluorophenyl)-1,3,4-oxadiazole rate] Zinc, a screw [2-(2-hydroxyphenyl)-5-(4-fluorophenyl)-1,3,4-oxadiazole rate] Beryllium, a screw [5-(4-chlorophenyl)-2-(2-hydroxyphenyl)-1,3,4-oxadiazole rate] Zinc, a screw [2-(2-hydroxyphenyl)-5-(4-methoxyphenyl)-1,3,4-oxadiazole rate] Zinc, a screw [2-(2-hydroxy-4-methylphenyl)-5-phenyl-1,3,4-oxadiazole rate] Zinc,

[0036]

Screw[2-alpha-(2-hydroxynaphthyl)-5-phenyl-1,3,4-oxadiazole rate] Zinc, a screw [2-(2-hydroxyphenyl)-5-p-pyridyl 1,3,4-oxadiazole rate] Zinc, a screw [2-(2-hydroxyphenyl)-5-p-pyridyl 1,3,4-oxadiazole rate] Beryllium, a screw [2-(2-hydroxyphenyl)-5-(2-thiophenyl)-1,3,4-oxadiazole rate] Zinc, a screw [2-(2-hydroxyphenyl)-5-phenyl-1,3,4-thiadiazole rate] Zinc, a screw [2-(2-hydroxyphenyl)-5-phenyl-1,3,4-thiadiazole rate] Beryllium, a screw [2-(2-hydroxyphenyl)-5-(1-naphthyl)-1,3,4-thiadiazole rate] Zinc and a screw [2-(2-hydroxyphenyl)-5-(1-naphthyl)-1,3,4-thiadiazole rate] Beryllium etc. are mentioned. Another suitable classes of non-anthracene and a non-triazine derivative compound are quinoline, for example, 1,4-bis(4-phenylquinolin-2-yl) benzene, and 4,4'-bis(4-phenylquinolin-2-yl)-1,1'-biphenyl (TA).

[0037]

In an embodiment in which a luminous region adds to an organic electrophotoluminescence substance more than a kind, and contains an electron hole transportation substance more than a kind, and/or an electron transport substance more than a kind, A layer with separate organic electrophotoluminescence substance, electron hole transportation substance more than a kind,

and/or electron transport substance more than a kind, For example, are generable in OLED indicated by US,4,539,507,B, 4,720,432, and 4,769,292, In the same layer, it is generated and Or a mixing zone of two or more sorts of substances, for example, US,5,853,905,B, OLED indicated by 5,925,980, 6,130,001, 6,114,055, 6,392,250, and 6,392,339 can be formed.

Thickness of a luminous region may change from about 500A to about 1,500A from about 200A to about 2,000A especially typically from about 10A to about 10,000A, for example. In an embodiment in which a luminous region contains two or more layers, each layer thickness may be from about 100A to about 1,500A from about 50A to about 2,000A especially typically from about 10A to about 5,000A, for example.

[0038]

Each layer of OLED may cross layer thickness, generally it may have a uniform or un-uniform presentation, and each layer contains thoroughly a mixture of a kind of substance or a substance in this case.

OLED can be processed by forming a desired layer continuously on a base material using all suitable thin film coating technology and adhesion according to spin covering or the heat evaporation in a vacuum typically. The further details about processing and operation of an organic luminescent device are indicated by US,4,539,507,B and 4,769,292, for example.

the performance improved compared with OLED in which the organic luminescent device of this invention contains the other blue discharge OLED, for example, the anthracene derivative compound as released goods, and the quinoline type metal chelate derivative compound (this is not a triazine derivative compound) as an electron transport substance -- for example, Still higher operation stability and the improved color purity can be shown.

Especially all the % and number of copies are weight references unless it is shown.

[0039]

[Translation done.]

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EXAMPLE

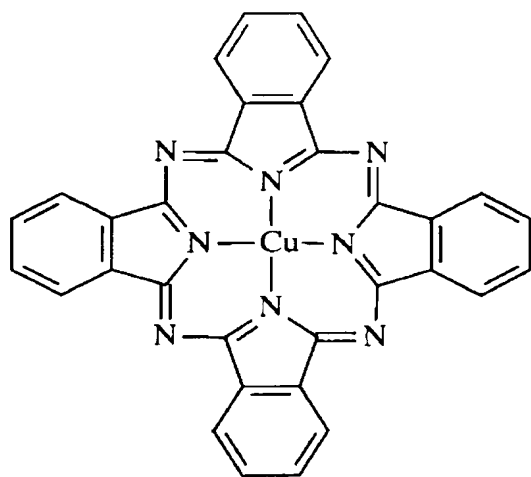
[Working example]

Embodiment 1

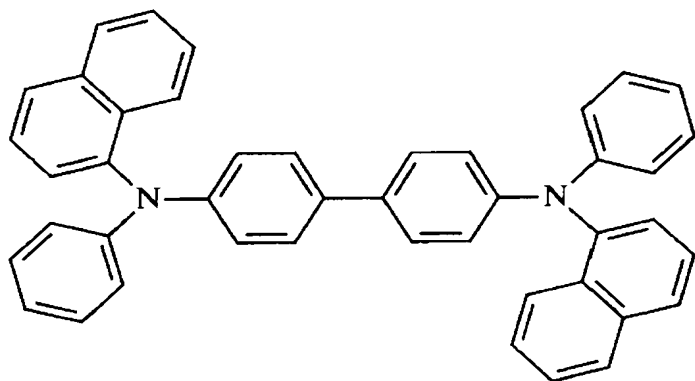
A structure ITO anode. (50 nm) / CuPc porphyrin compound buffer layer. (15 nm) / NPB3 -- a class aromatic amine compound electron hole transporting bed (30 nm) / BH2 anthracene-derivative compound emitter layer (30 nm) / T1 triazine-derivative compound electron transport layer (20 nm) / Mg:Ag cathode (the volume ratio of 9:1 of Mg:Ag.) A 200-nm organic luminescent device (called the equipment A among this Description) was processed. The molecular structure of CuPc, NPB, BH2, and T1 is as follows.

[0040]

[Chemical formula 16]



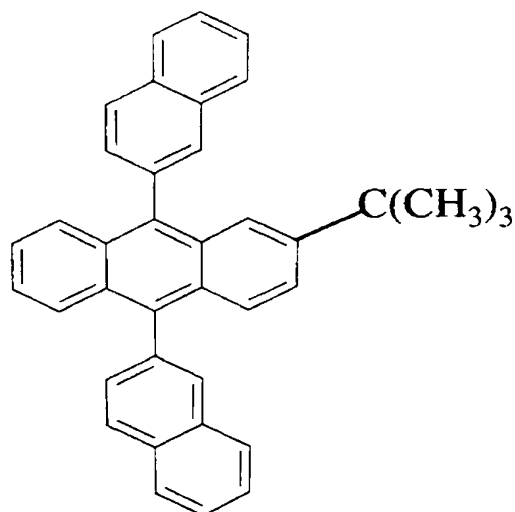
CuPc



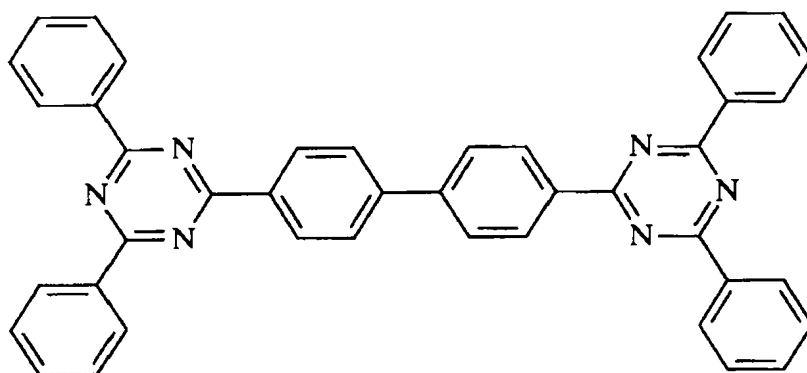
NPB

[0041]

[Chemical formula 17]



BH2



T1

[0042]

That equipment was processed by vacuum adhesion by the base pressure of the 5×10^{-6} torr, and heat evaporation of all the organic layers and cathodes was carried out in this case on the ITO covering glass support body front-washed using UV-ozone cleaning.

Current density = when it operated using 31.25 mA/cm^2 , the equipment produced the color purity which is equivalent to coordinates (0.144, 0.083) with blue discharge and the CIE chart of the strength of 240 cd/m^2 . The operation voltage needed for operating equipment on these conditions was 8.7 volts. After the continuous operation of 60 hours, attenuation of discharge strength was less than 1% of early strength in this current density under a nitrogen atmosphere.

Comparative example 1

[Translation done.]

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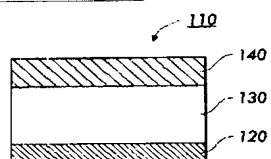
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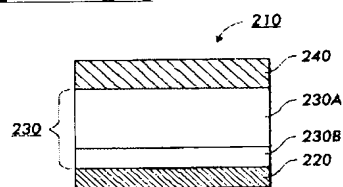
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DRAWINGS

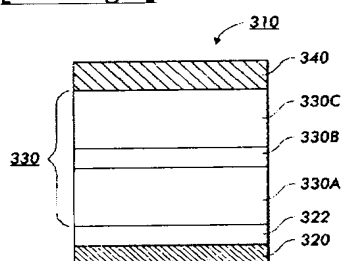
[Drawing 1]



[Drawing 2]



[Drawing 3]



[Translation done.]